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APRIL 1949

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Contour lines are constructed by red arrows based on rawins taken at 0300 G.C.T. those indicated by red arrows based on rawins taken at 0300 G.C.T.

CORRECTIONS

MONTHLY WEATHER REVIEW, November 1948, vol. 76, page 263: Coordinates of Naval Ordnance Test Station, Inyokern, China Lake, Calif., should read: "Longitude 117°49' W., Latitude 35°39' N."

January 1949, vol. 77, page 26: Speed of the fastest mile for Salt Lake City, Utah, should read "39".

February 1949, vol. 77, page 51: Speed of the fastest mile for Salt Lake City, Utah, should read "49".

MONTHLY WEATHER REVIEW

Editor, James E. Caskey, Jr.

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THE UNUSUAL WEATHER AND CIRCULATION OF THE 1948-49 WINTER

William H. Klein

[Extended Forecast Section, U. S. Weather Bureau]

Manuscript received May 12, 1949

Introduction

The 1948–49 winter season was characterized by marked extremes of weather in different parts of the world. Most important, perhaps, was the severe and prolonged drought which seriously hampered postwar economic recovery in southern Europe. In addition, record amounts of rainfall were recorded in the Hawaiian Islands, extreme cold prevailed in Alaska and western Canada, unusually mild weather was experienced in western Europe and Mexico, and abnormal storminess persistently recurred in most of the Soviet Union. But the most spectacular weather of all occurred in the United States, where blizzards in the Great Plains and Rocky Mountain regions, freezes and snow in California, Arizona, and Texas, and ice storms in the midwest set new records for duration, frequency, and intensity and necessitated use of air lift and bulldozer tactics to save starving and freezing livestock.

Figure 1 shows that this winter's temperatures averaged as much as 10° F. below the seasonal normal in the western half of the United States and as much as 8° F. above normal in the eastern half of the country, while precipitation exceeded the normal amount nearly everywhere except in the Northwest and Southeast. This general pattern of weather anomalies first became evident at the end of October, slowly intensified during November and December, reached its most extreme state during January, and gradually abated during February and March. Not since the winter of 1889–90 has there been such a prolonged period of cold weather in the West and warm weather in the East. Although individual winter months have been more extreme, mean temperatures for this season as a whole were the lowest of record in at least one station in every State west of the Continental Divide and the highest of record at Blue Hill (and probably other places) in New England.[1]

The question naturally arises: "Was there any logical connection between the exceptional winter weather in the United States and the aberrations of weather in the rest of the world?" In order to demonstrate that such an interrelationship actually did exist, an attempt will be made to show, first, that the observed anomalies of weather were closely associated with equally well-marked and persistent anomalies of the general circulation, and, second, that many features of the observed circulation evolved in an orderly fashion consistent in part with known physical principles.

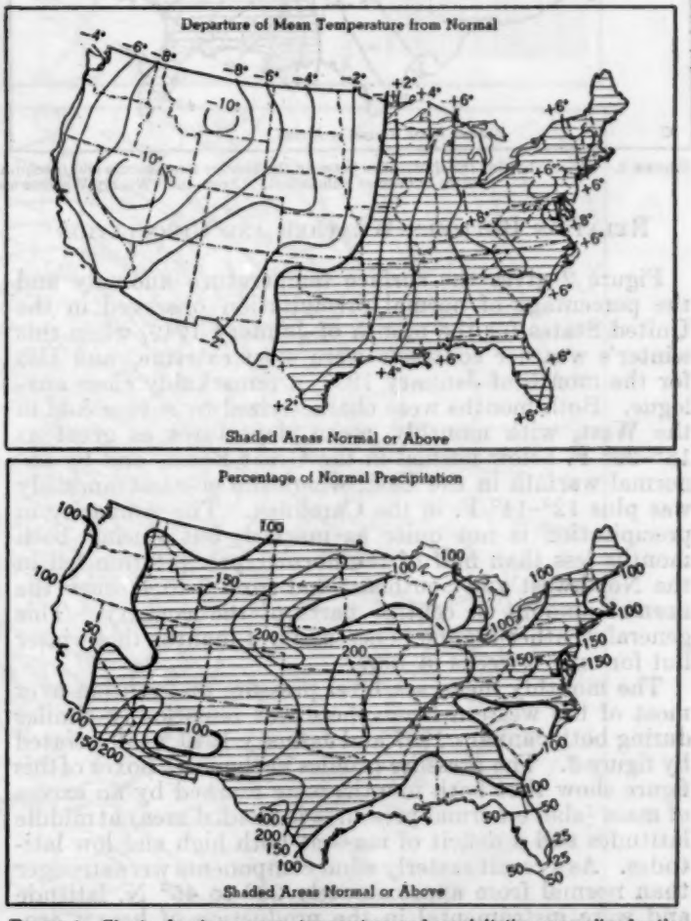

Departure of Mean Temperature from Normal
Shaded Areas Normal or Above
Percentage of Normal Precipitation
Shaded Areas Normal or Above

Figure 1.—Charts showing average temperature and precipitation anomalies for the winter of 1948–49 (December through February). Temperature departure from normal is shown in degrees Fahrenheit. (From the "Weekly Weather and Crop Bulletin" for the week ending March 8, 1949.)

[1] Many interesting details of this winter's weather in the United States are described in the following U. S. Weather Bureau publications: "Monthly Weather Review" (for each month of the winter), "Weekly Weather and Crop Bulletin" (particularly the issue for the week ending February 8, 1949), and "Daily Weather Map" (particularly analyzed series No. 42 by L. Kiviat issued April 12 and 13, 1949). Also noteworthy is the report on "Winter Weather of 1948–49 at the Blue Hill Meteorological Observatory of Harvard University, Milton, Massachusetts" and the following publications of the Amateur Weathermen of America: "Weatherwatch" (for each month of the winter) and "Weatherwise" (especially articles by Cameron, Klein, and Sorenson in vol. 2, No. 2, April 1949). Mean monthly anomalies of temperature and precipitation at selected stations throughout the world can be found in the U. S. Weather Bureau publication: "Monthly Climatic Data for World."

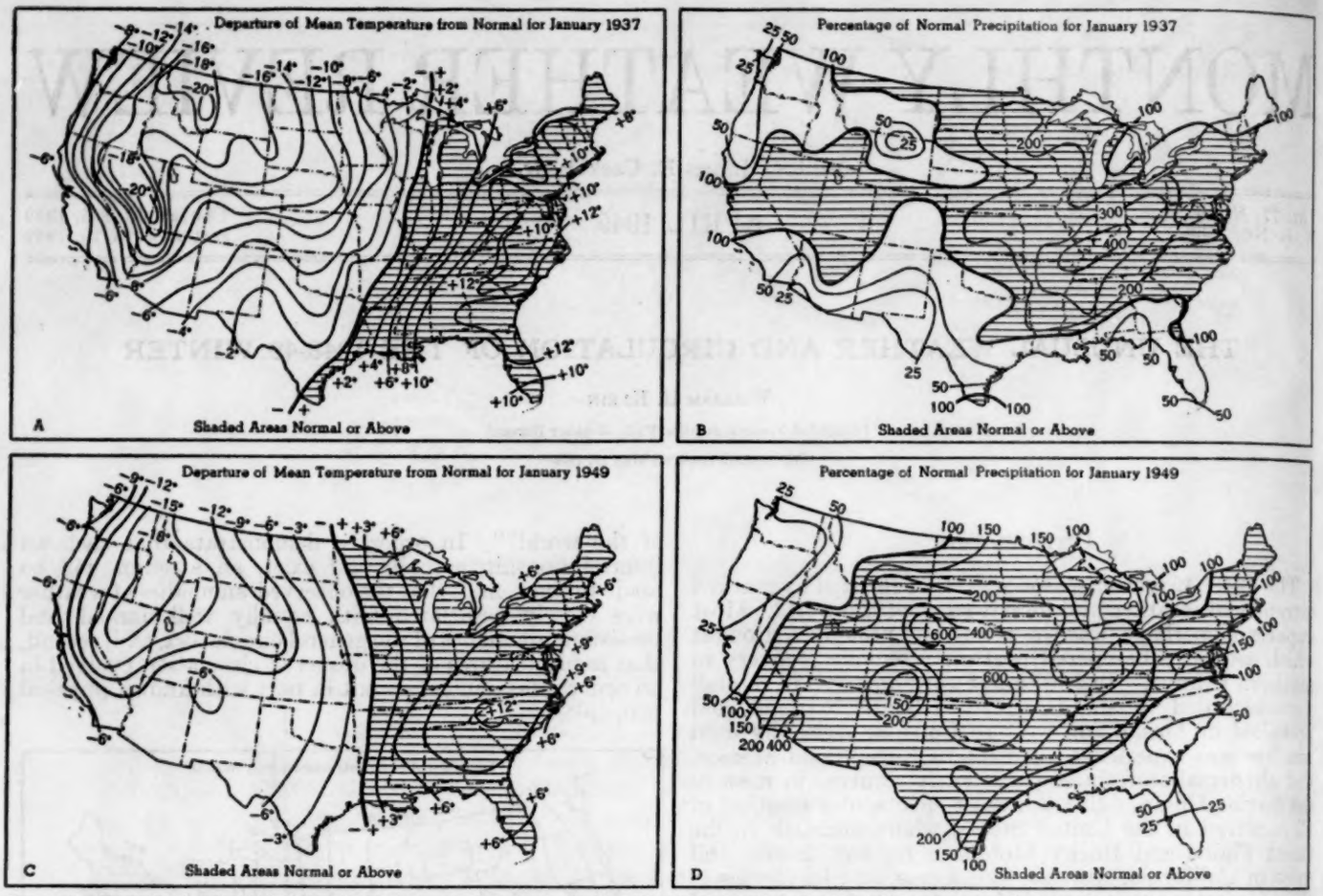

Departure of Mean Temperature from Normal for January 1937
A
Shaded Areas Normal or Above
Percentage of Normal Precipitation for January 1937
B
Shaded Areas Normal or Above
Departure of Mean Temperature from Normal for January 1949
C
Shaded Areas Normal or Above
Percentage of Normal Precipitation for January 1949
D
Shaded Areas Normal or Above

FIGURE 2.—Charts showing the similarities between the average temperature and precipitation anomalies for January 1937 and January 1949. Temperature departure from normal is shown in degrees Fahrenheit. (From the "Weekly Weather and Crop Bulletin" for the first week of February 1937 and 1949.)

RELATION BETWEEN WEATHER AND CIRCULATION

Figure 2 gives the surface temperature anomaly and the percentage of normal precipitation observed in the United States for the month of January 1949, when this winter's weather contrasts were most extreme, and also for the month of January 1937, a remarkably close analogue. Both months were characterized by severe cold in the West, with monthly mean departures as great as 18°–20° F. below normal in the Great Basin, and by abnormal warmth in the East, where the greatest anomaly was plus 12°–14° F. in the Carolinas. The similarity in precipitation is not quite as marked, but during both months less than half of the normal precipitation fell in the Northwest and Southeast and from 2 to 4 times the normal amount in central parts of the country. This general weather regime persisted for 4 months this winter but for only 6 weeks in 1937.

The monthly mean sea level pressure distribution over most of the western hemisphere was remarkably similar during both January 1937 and January 1949, as illustrated by figure 3. The pressure profiles in the inset boxes of this figure show that both months were marked by an excess of mass (above-normal pressures in shaded area) at middle latitudes and a deficit of mass at both high and low latitudes. As a result easterly wind components were stronger than normal from approximately 20° to 45° N. latitude and were instrumental in the production of heavy orographic rain in the Hawaiian Islands, warm moist maritime weather in the eastern United States and Mexico, and dry continental conditions on the west coast of the United States (and in southern Europe in January 1949). It is noteworthy that both this winter and the abnormal winter of 1946–47 described by Namias [1] were characterized by a low zonal index; but this was brought about by a northward displacement of the middle-latitude westerlies this winter, in contrast to their shift southward during the winter of 1946–47 when conditions were similar to the typical low index conditions described by Willett [2].

Other striking features of both mean sea level charts in figure 3 are first, the northward displacement of the Great Basin and eastern Pacific Highs, which diminished the frequency of warm dry foehn winds east of the continental divide and produced cold northeasterly winds instead in the western United States (as in western Europe two winters ago); and second, the westward intrusion of the Bermuda High, with its attendant moist maritime tropical air, into the eastern United States. The circulation features in the entire Pacific area were markedly similar during both January 1937 and January 1949, with the Aleutian Low deeper and farther northwest than normal, the Eastern Pacific High stronger and farther north than normal, and an anomalous low-latitude trough near the Hawaiian Islands. This pattern closely resembles the ideal pressure pattern for general heavy rain in the Hawaiian Islands given by Solot and Haggard [3], and such

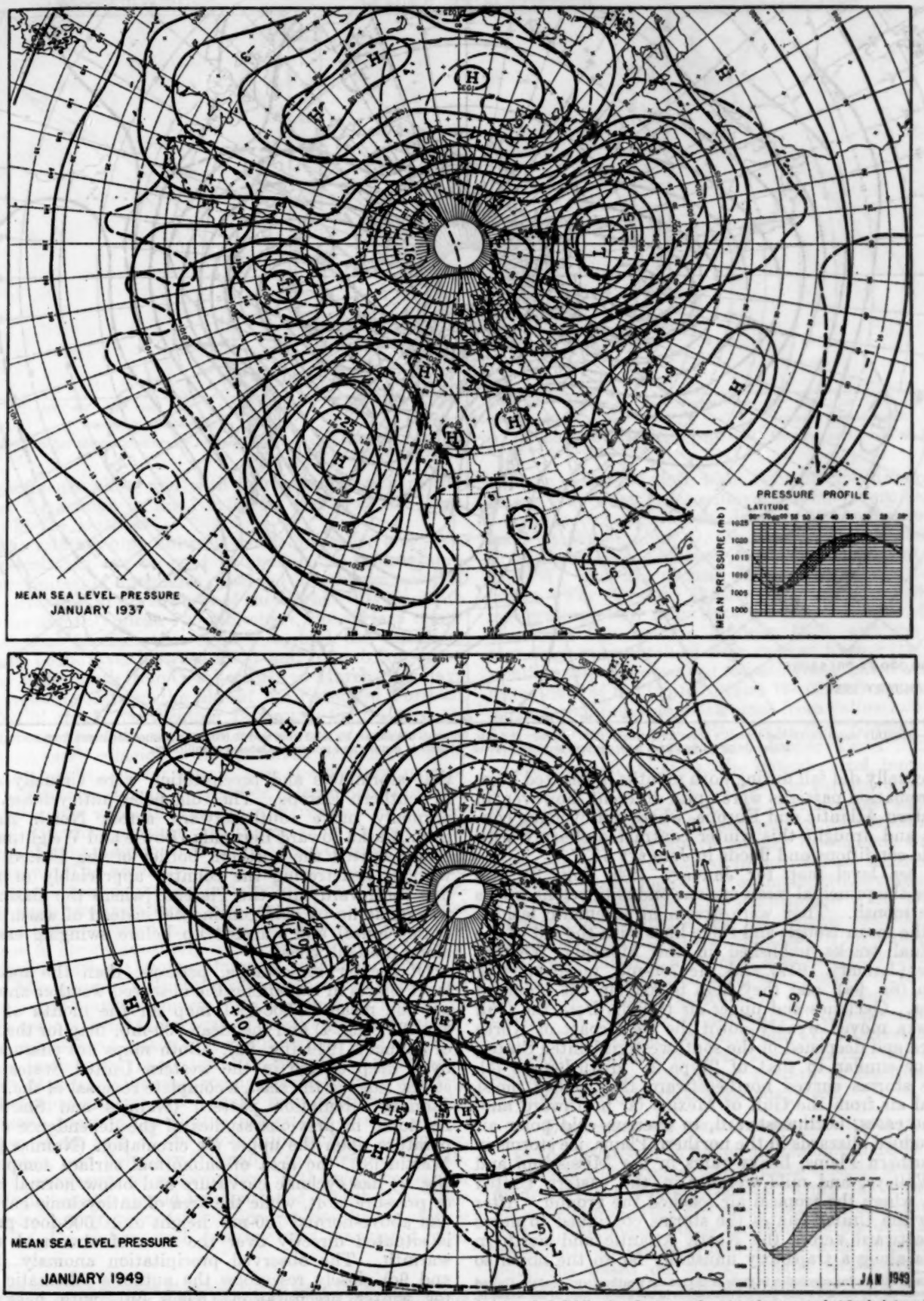


FIGURE 3.—Mean sea level charts for January 1937 and January 1949 showing isobars at 5-mb. intervals (solid lines) and pressure departure from normal at 5-mb. intervals (dashed lines, with zero isopleth heavier). Anomaly centers and isobars are labeled in millibars. Solid arrowhead curves represent idealized mean cyclone tracks and the open arrowhead curves the idealized mean anticyclone tracks. Inset shows observed Western Hemisphere pressure profile (from 20° to 90° N. latitude) as a solid curve and normal pressure profile as a dashed curve with excess anomalies shaded.

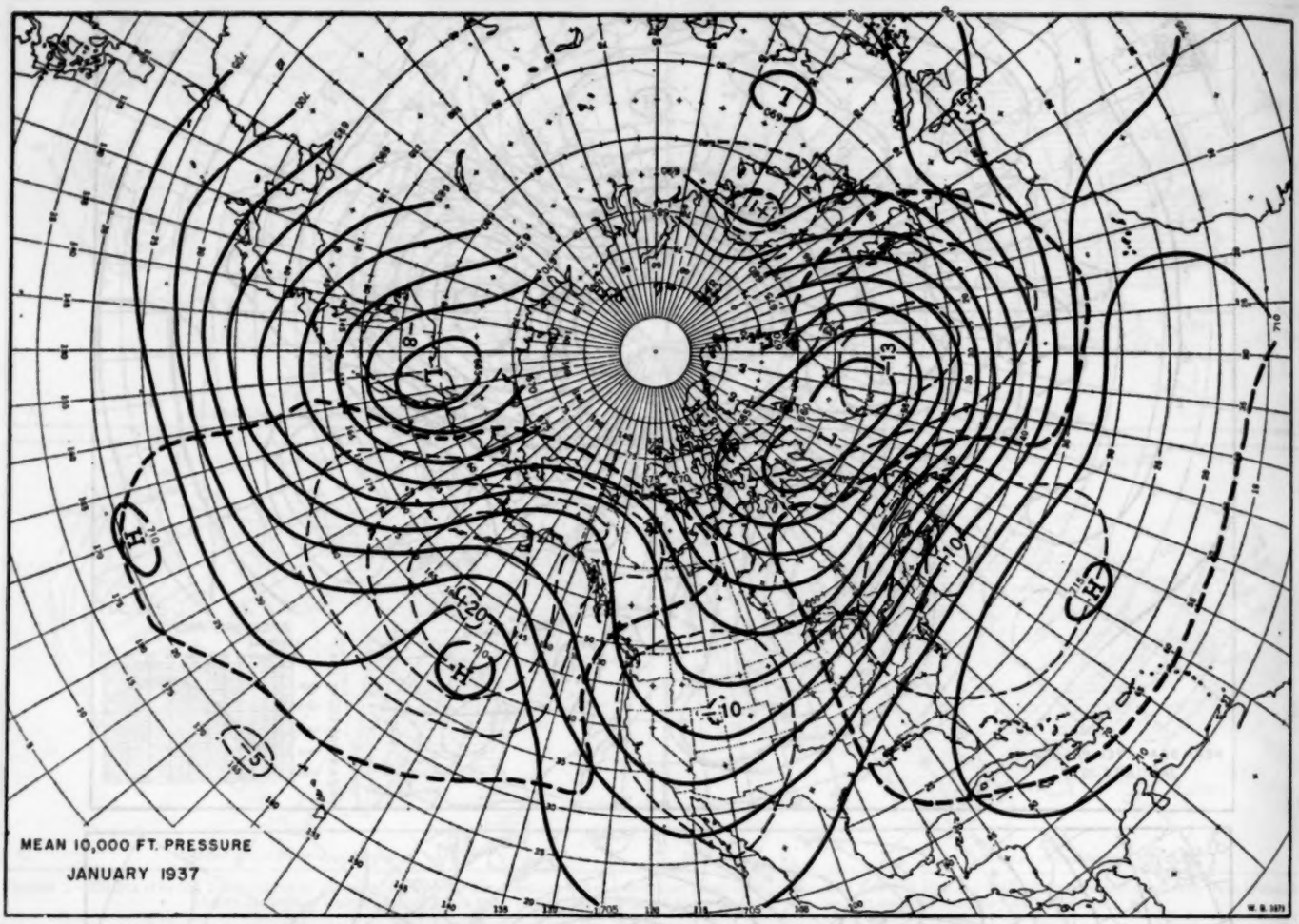


FIGURE 4.—Monthly mean 10,000-foot pressure chart for January 1937. Isobars at 5-mb. intervals are shown by solid lines and 10,000-foot pressure departure from normal at 5-mb. intervals by dashed lines with the zero isopleth heavier. Anomaly centers and isobars are labeled in millibars.

rains actually did fall during both months illustrated here. The circulation patterns were quite different, however, in the eastern Atlantic and Europe, where anticyclonic conditions and drought this winter contrasted sharply with cyclonic conditions and floods in January 1937.[2]

The sea level map for January 1949 (fig. 3) also includes the principal mean cyclone and anticyclone tracks for the month. They were drawn in schematic fashion along the mean trough and ridge lines with the aid of the individual tracks published in the Monthly Weather Review (January 1949) and the 700-mb. mean steering pattern (fig. 9a), and they help to explain the observed weather. Cyclones and upper-air troughs from the Gulf of Alaska moved weakly down the west coast of North America and deepened in the southwestern United States, behavior similar to that of "type A" disturbances [4]. As the storms curved northeastward they pulled moist tropical air from the Gulf of Mexico far northward and, in some cases, northwestward, to overrun cold polar air and produce blizzards in the northern Plains, ice storms in the southern Plains, heavy rains in the Mississippi and Ohio Valleys, and mild weather in the eastern United States, where the tropical air reached the ground. After leaving the United States the storms continued to move northeastward across the North Atlantic and northern Eurasia along a trajectory unusually far to the north so that storminess and precipitation were virtually absent in southern Europe. The cold polar anticyclones which normally move southeastward across North America from Alaska toward Bermuda (Bowie and Weightman [5]) either skirted the northern border of the United States without penetrating the country appreciably or moved due southward into the Plateau (where the Basin High was made up by cold continental instead of warm Pacific anticyclones) and warmed up before swinging eastward along the Gulf coast.

Of greater importance, perhaps, than the mean sea level charts in explaining the observed weather anomalies are the mean 10,000-foot map for the month of January 1937 (fig. 4) and the mean 700-mb. map for the month of January 1949 (fig. 9a). Both maps are characterized by a deep trough in the western United States and a strong ridge in the East, a complete reversal of the normal January circulation pattern (Namias and Smith [6]). As noted in previous studies of the dependence of temperature upon the upper air circulation (Namias [7] and Martin [8]), the area of subnormal surface temperature (fig. 2) has cyclonic curvature and below normal heights or pressure aloft, while the area of anticyclonic curvature and above-normal 700-mb. height or 10,000-foot pressure is situated directly over the area of abnormal surface warmth. The observed precipitation anomaly (figs. 2 and 9c) closely resembles the author's schematic model for winter precipitation (Klein [9]), with heavy precipitation oriented from southwest to northeast along and ahead of the 700-mb. trough in southwesterly flow

[2] There is an interesting suggestion in these facts that the weather in most of the United States is more closely related to the general circulation in the Pacific than in the Atlantic. This hypothesis is supported by unpublished results recently obtained by D. E. Martin of the Extended Forecast Section of the U. S. Weather Bureau which show that the five-day mean temperature anomaly at most stations in the United States is highly correlated with the 700-mb. height anomaly in the Gulf of Alaska region.

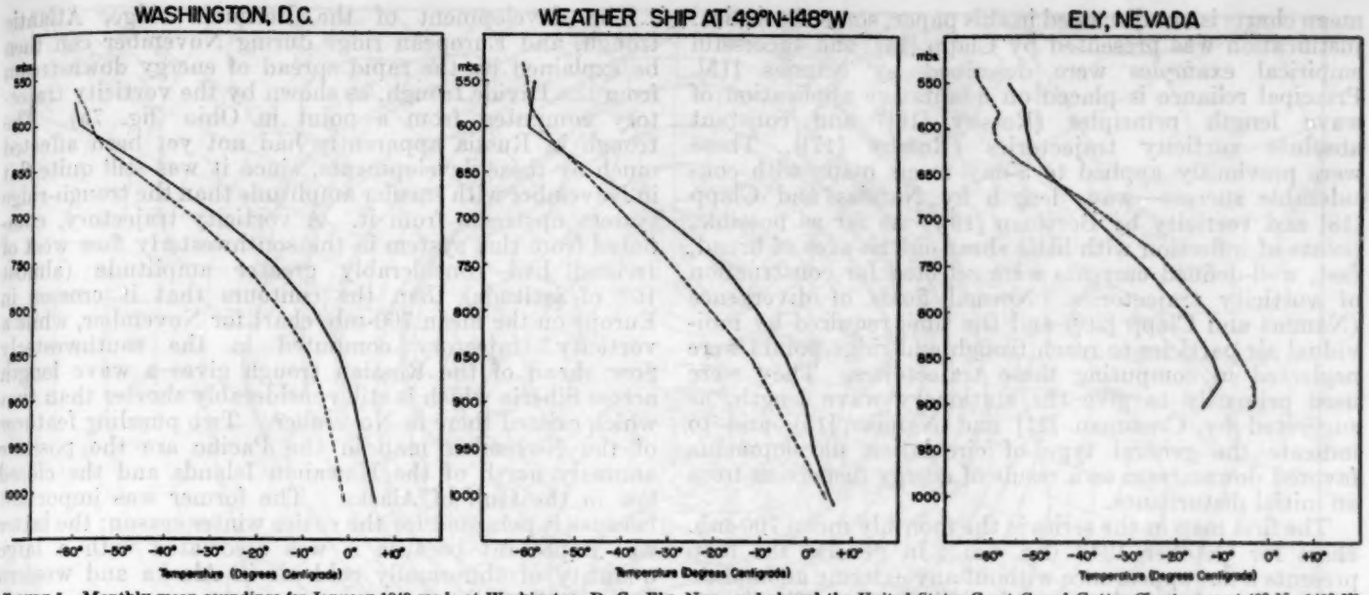


FIGURE 5.—Monthly mean soundings for January 1949 made at Washington, D. C., Ely, Nev., and aboard the United States Coast Guard Cutter *Chautauqua* at 49° N., 148° W. The normal January soundings are shown as dashed lines.

and confluence aloft, and with light precipitation in the rear of the trough in the Northwest and near the High center in the Southeast.

These relationships between surface weather and 700-mb. circulation can be used to explain the temperature and precipitation anomalies observed in other months of this winter and in other parts of the world. To illustrate this, the monthly mean 700-mb. chart, the surface temperature and precipitation anomalies, and the thickness anomaly of the layer between 1,000- and 700-mb.[3] observed during each month from October 1948 to March 1949 have been reproduced from the files of the Extended Forecast Section of the U. S. Weather Bureau in figures 6 to 11. For the most part the regions of below-normal temperature (or thickness) coincide with the areas of below-normal 700-mb. height, as, for example in the western part of North America during November, December, January, and February; while the regions of above-normal temperature lie in close proximity to the areas of above-normal 700-mb. height, as in most of Europe from October through February. The anomaly of gradient air flow relative to the normal is also important in determining surface temperature and precipitation. For example, above-normal temperatures occurred in regions of below-normal heights because of strong southerly winds relative to the normal in Mexico during October, January, and February, and in the Mississippi Valley during November and December; while below-normal temperatures occurred in regions of above-normal heights because of northerly wind components in western Canada and northwestern United States during January and in western Europe and Central Siberia during March. Likewise, stronger-than-normal westerly wind components produced heavy precipitation along the northwest coast of the United States but created a rain-shadow effect east of the mountains during November, December, and February. Finally, the effect of 700-mb. contour curvature on precipitation in the western part of the United States should be mentioned (Smith [11]). For example, heavy precipitation in the Southwest during October, December, and January was associated with cyclonic curvature aloft, while light precipitation occurred during November with anticyclonic curvature aloft.

In figure 5 are shown the January 1949 mean soundings made at Washington, D. C., Ely, Nev., and aboard the U. S. Coast Guard Cutter *Chautauqua* located at 49° N., 148° W., and the normal January soundings for these points. For Ely and Washington, the observed soundings were plotted from data published in the MONTHLY WEATHER REVIEW for January 1949, and the normal soundings were obtained from data of Ratner [12]; for the weather ship the observed sounding was based on unpublished data of the United States Weather Bureau, and the normal sounding was constructed from values interpolated among the isobers and isotherms on the "Normal Weather Maps Northern Hemisphere Upper Level". At Ely, where a trough existed at the 700-mb. level, temperatures were below normal not only at the surface but at every level of the troposphere. At Washington and at the position of the U. S. *Chautauqua*, in the 700-mb. ridges, temperatures were above normal throughout the entire troposphere. As expected from previous studies of cold lows and warm highs (for example, Rossby and Willett [13]) the tropopause and stratosphere were lower and warmer than normal at Ely and higher and colder than normal at Washington and the ship. It is thus apparent that we are dealing with large scale and persistent anomalies of the general circulation which appeared throughout the entire observed atmosphere of the Northern Hemisphere. A complete explanation of this phenomenon in terms of all possible terrestrial and extra-terrestrial causes is beyond the scope of this paper. Instead the observed evolution of the circulation pattern is described and a possible physical explanation suggested.

EVOLUTION OF THE OBSERVED CIRCULATION

In the discussion to follow an attempt is made to apply kinematic and physical principles to troughs and ridges on monthly mean 700-mb. charts. Only the mean charts for calendar months are reproduced here (figs. 6 to 11, part a), but mean charts for monthly periods from each mid-month to the next mid-month with kinematic computations based on 10-day height tendencies centered around each mean were also used to confirm the continuity ascribed to the principal circulation features. The propriety of applying physical principles to monthly

[3] In view of the high correlation which exists between surface temperature and mean virtual temperature of the layer between the surface and 10,000 feet (Rowe [10]), the 1,000 to 700-mb. thickness anomaly has been used instead of the surface temperature anomaly in regions outside the United States where class limits for surface temperature are not available.

mean charts is not discussed in this paper; some theoretical justification was presented by Clapp [14], and successful empirical examples were described by Namias [15]. Principal reliance is placed on qualitative application of wave length principles (Rossby [16]) and constant absolute vorticity trajectories (Rossby [17]). These were previously applied to 5-day mean maps with considerable success—wave length by Namias and Clapp [18] and vorticity by Bortman [19]. As far as possible, points of inflection with little shear on the axes of broad, fast, well-defined currents were selected for construction of vorticity trajectories. Normal fields of divergence (Namias and Clapp [20]) and the time required by individual air particles to reach trough and ridge points were neglected in computing these trajectories. They were used primarily to give the stationary wave length, as suggested by Cressman [21] and Namias [15], and to indicate the general type of circulation developments favored downstream as a result of energy dispersion from an initial disturbance.

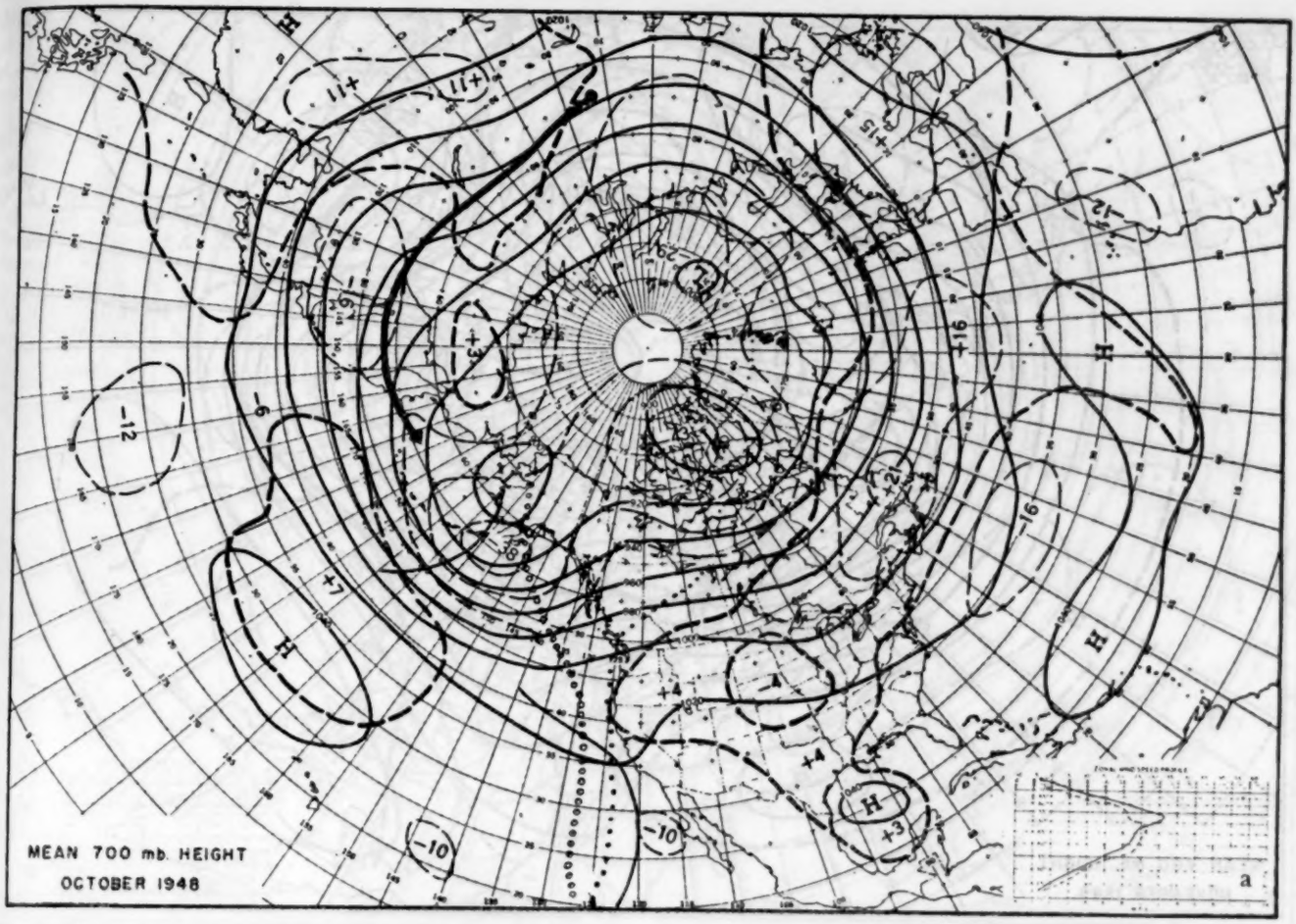
The first map in the series is the monthly mean 700-mb. chart for October 1948 (fig. 6a). In general the map presents a flat appearance without any extreme anomalies. The western hemisphere zonal wind speed profile (inset) shows that during October there was a well defined mean jet stream [22] between 50° and 55° N. latitude, 5° north of the jet position on the normal profile (dashed). The line of dots along the west coast of North America gives the position of a monthly mean trough during August, the line of open circles shows the position of this same mean trough during the month of September, and the solid curves give the trough position during October. It can be seen that the entire trough retrograded from August to September, but the trough sheared in October, with the upper portion continuing to retrograde and the lower portion reversing its motion and starting eastward. As a result a Low was located directly north of a High in the central Pacific during October with a band of abnormally fast westerlies in between. Continued retrogression was favored for the trough in the north by the existence of an extremely long wave length between it and the next high latitude trough upstream in Europe. This wave length was considerably longer than the stationary wave length given by the vorticity trajectory computed from the mean southwesterly flow in Siberia (fig. 6a). Conditions were unfavorable for retrogression in the south, however, because of the presence of a low latitude trough in the western Pacific during October.

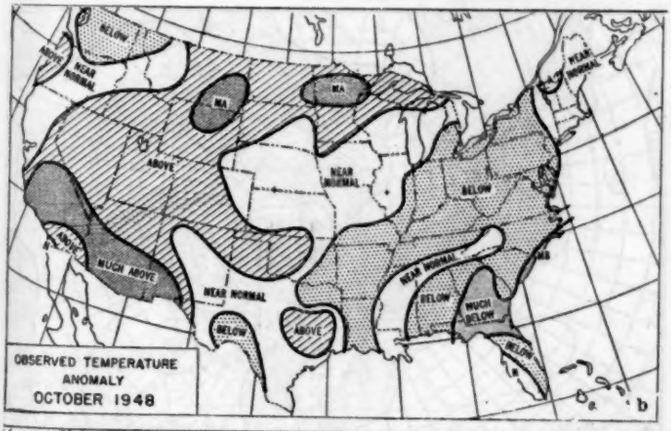
The monthly mean 700-mb. chart for November is reproduced in figure 7a. It shows that the flat circulation of the preceding month was replaced by a series of well-marked waves in the westerlies. As frequently happens on five-day mean maps (Willett [2]), this increase in amplitude was associated with a southward shift of the jet stream to a location between 40° and 45° N. latitude, 5° south of the normal and 10° south of the October position. It is possible that these changes were initiated by dynamic factors operating on the unusually fast westerly current set up in the central Pacific in October (and maintained during November) and tending to produce a trough to the lee of the Rocky Mountain range. The development of this "Divide trough" was favored by the presence of abnormally cold air off the West Coast during October and November (figs. 6d and 7d) and by the fact that a low-latitude trough, such as the one off California in October, normally tends to separate from its high latitude portion and build to higher latitudes subsequent to shearing (Namias and Clapp [18]).

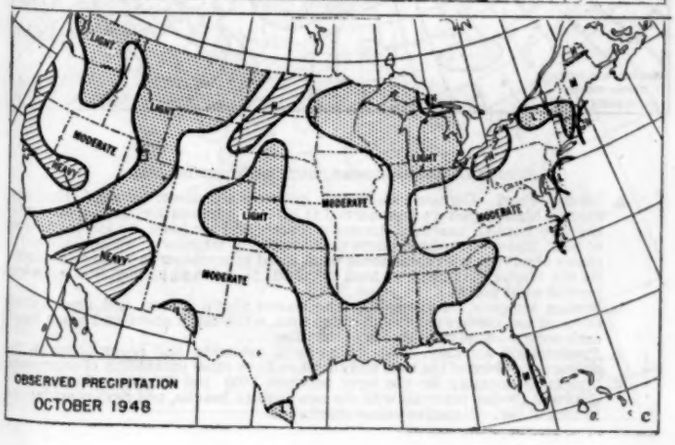
The development of the Bermuda ridge, Atlantic trough, and European ridge during November can then be explained by the rapid spread of energy downstream from the Divide trough, as shown by the vorticity trajectory computed from a point in Ohio (fig. 7a). The trough in Russia apparently had not yet been affected much by these developments, since it was still quite flat in November with smaller amplitude than the trough-ridge system upstream from it. A vorticity trajectory, computed from this system in the southwesterly flow west of Ireland had considerably greater amplitude (almost 10° of latitude) than the contours that it crosses in Europe on the mean 700-mb. chart for November, while a vorticity trajectory computed in the southwesterly flow ahead of the Russian trough gives a wave length across Siberia which is still considerably shorter than that which existed there in November. Two puzzling features of the November map in the Pacific are the positive anomaly north of the Hawaiian Islands and the closed low in the Gulf of Alaska. The former was important because it persisted for the entire winter season; the latter was important because it was associated with a large quantity of abnormally cold air in Alaska and western Canada (fig. 7d).

The next map in the series is that for December 1948 (fig. 8a). The mean jet stream remained essentially unchanged between 40° and 45° N. latitude. The upper portion of the Pacific trough continued its long period retrogression from its October position in the Gulf of Alaska and its November position in the Bering Sea, and joined the low-altitude trough off Japan to form a single strong full-latitude trough in the western Pacific. In part as a result of the dispersion of energy downstream from this trough, a strong full-latitude ridge with a tremendous positive anomaly of 530 feet developed in the east central Pacific, while trough conditions and below normal heights intensified over western North America. At the same time the Gulf of Alaska trough was forced eastward to the Alaskan coast by the short wave length between it and the trough in the Bering Sea in November, as indicated by the vorticity trajectory passing through the area (fig. 7a). As a result of these developments, negative heights and northerly wind components (relative-to-normal) produced an extreme thickness anomaly of −500 feet in the lowest 3 km. of the atmosphere in the Yukon (fig. 8d). In accordance with November's vorticity trajectory in the Atlantic, the circulation pattern increased its amplitude considerably in Eurasia, where larger anomalies of +400 feet and −550 feet appeared during December. In response to this increase in amplitude, both wave length and wind speed over Eurasia increased (Bortman [23]), and the Russian trough moved about 25° longitude to the east. As a result of this eastward motion and strengthened circulation, a vorticity trajectory originating in the strong northwesterly flow in Russia places a trough (at 54° N., 164° E.) just east of the position occupied by the Pacific trough in December, puts a crest in Alaska, and has greater amplitude than the contours observed in the Pacific in December. At the same time, a vorticity trajectory computed in the strong southwesterly flow south of the Aleutians cuts across three of the contours observed in the United States on the mean 700-mb. chart for December. The two trajectories approach each other and indicate a zone of confluence (Namias [24]) near James Bay.

The next map in the series is that for January 1949 (fig. 9a). It shows that the January jet stream was centered between 50° and 55° N. latitude, 5° north of







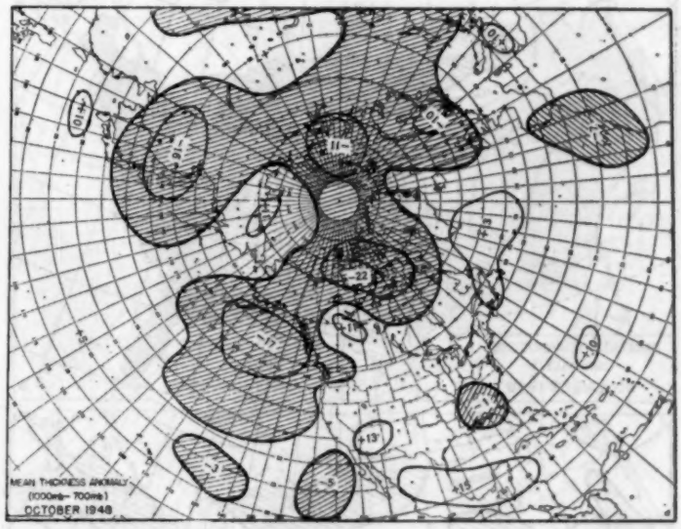


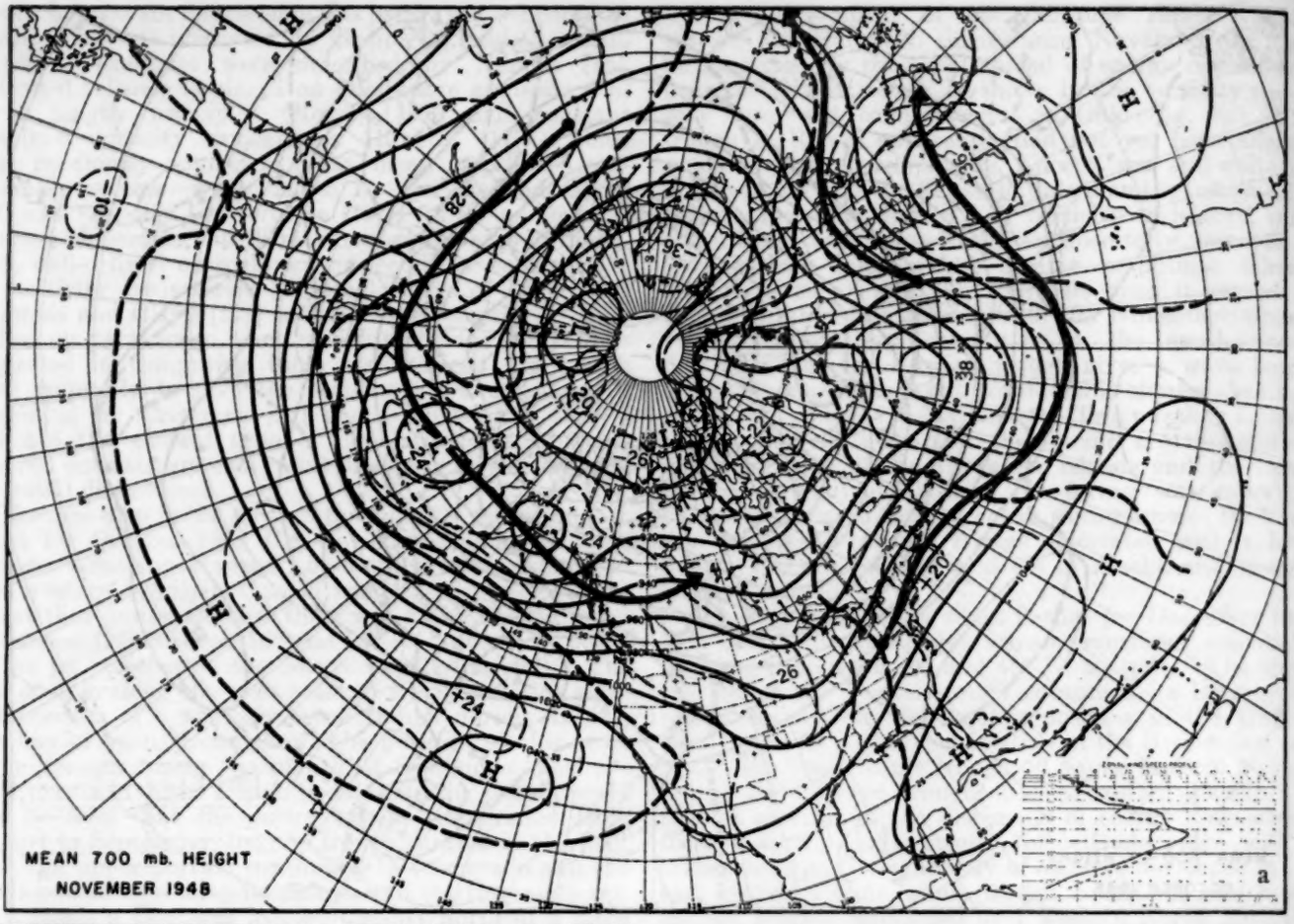
FIGURE 6.—Monthly mean charts for October 1948.

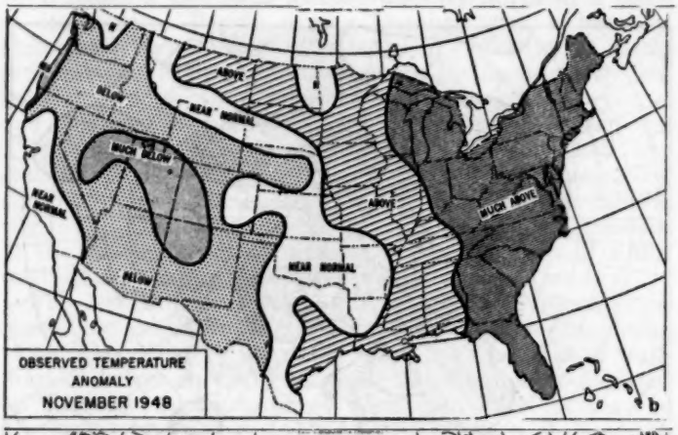
a. 700-mb. chart. Contours at 200-foot intervals are shown by solid thin lines, 700-mb. height departure from normal at 100-foot intervals by dashed lines with the zero isopleth heavier. Anomaly centers and contours are labeled in tens of feet. Heavy arrowhead curve shows vorticity trajectory. Mean positions of Pacific trough during August, September, and October 1948 are shown by dotted line, line of open circles, and solid line, respectively. Inset: Solid curve shows observed geostrophic zonal wind speed components in meters per second for the Western Hemisphere from 20° to 90° N. latitude; dashed line represents normal wind profile.

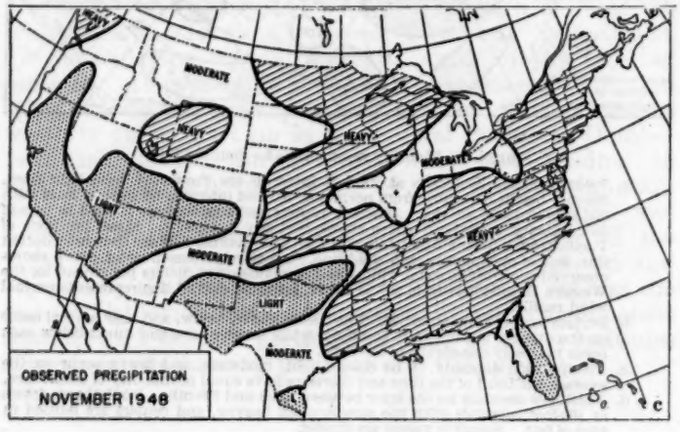
b. Surface temperature anomaly. The classes above, below, and near normal occur on the average one-fourth of the time, while much above and much below each occur normally one-eighth of the time.

c. Precipitation anomaly. The classes light, moderate, and heavy occur on the average one-third of the time and therefore have equal probability of occurrence.

d. Thickness anomaly for the layer between 1,000- and 700-mbs. Isopleths are drawn at 100-foot intervals with the zero isopleth heavier, and centers are labeled in tens of feet. Negative values are shaded.







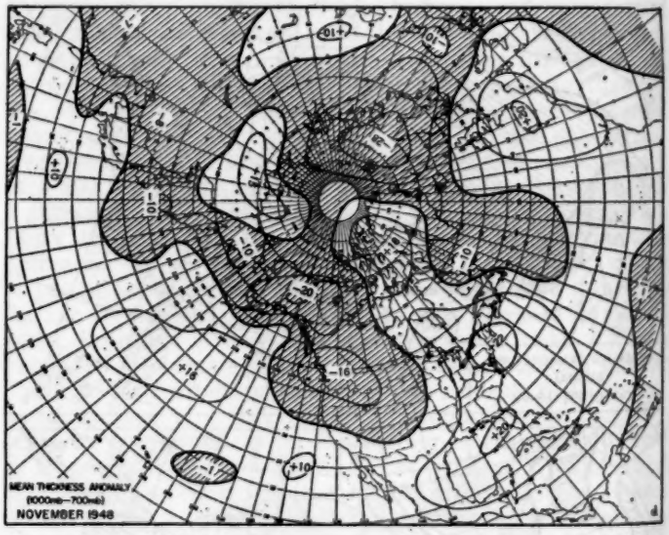


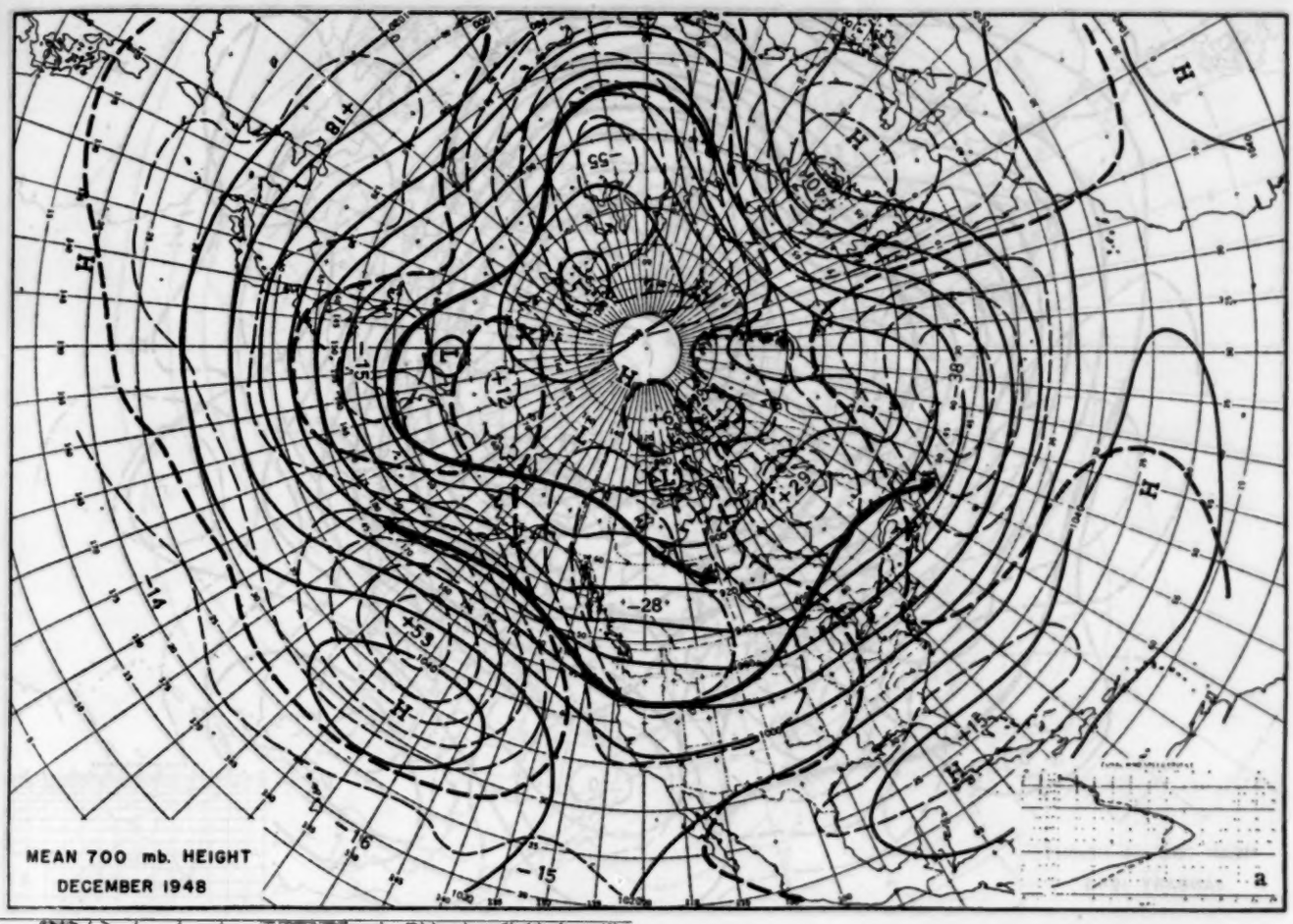
FIGURE 7.—Monthly mean charts for November 1948.

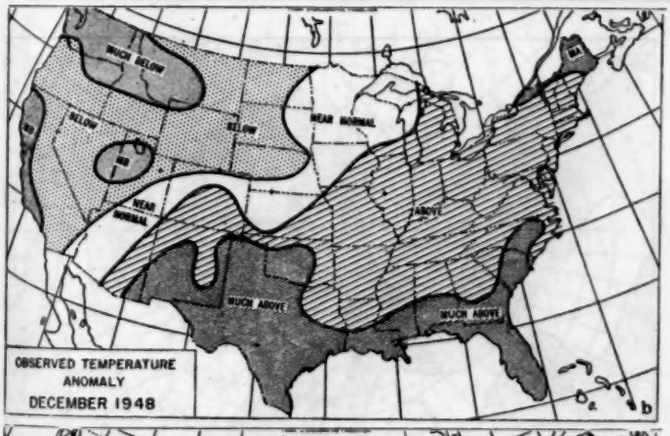
a. 700-mb. chart. Contours at 200-foot intervals are shown by solid thin lines, 700-mb. hight departure from normal at 100-foot intervals by dashed lines with the zero isopleth heavier. Anomaly centers and contours are labeled in tens of feet. Heavy arrowhead curve shows vorticity trajectory. Inset: Solid curve shows observed geostrophic zonal wind speed components in meters per second for the Western Hemisphere from 20° to 90° N. latitude; dashed line represents normal wind profile.

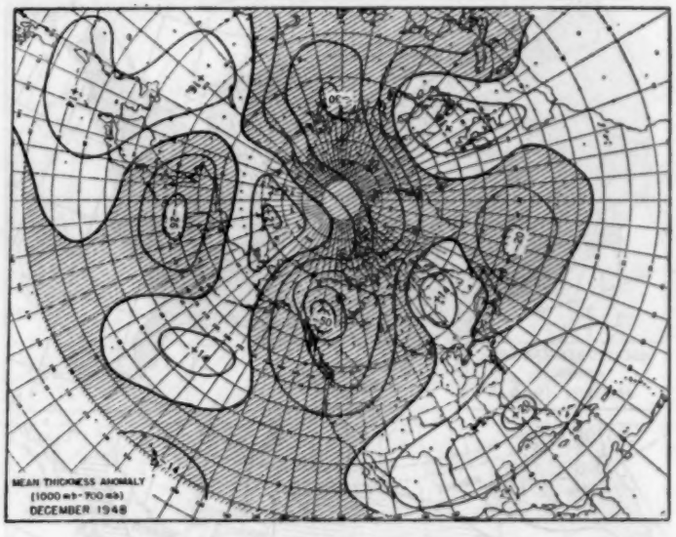
b. Surface temperature anomaly. The classes above, below, and near normal occur on the average one-fourth of the time, while much above and much below each occur normally one-eighth of the time.

c. Precipitation anomaly. The classes light, moderate, and heavy occur on the average one-third of the time and therefore have equal probability of occurrence.

d. Thickness anomaly for the layer between 1,000- and 700-mbs. Isopleths are drawn at 100-foot intervals with the zero isopleth heavier, and centers are labeled in tens of feet. Negative values are shaded.







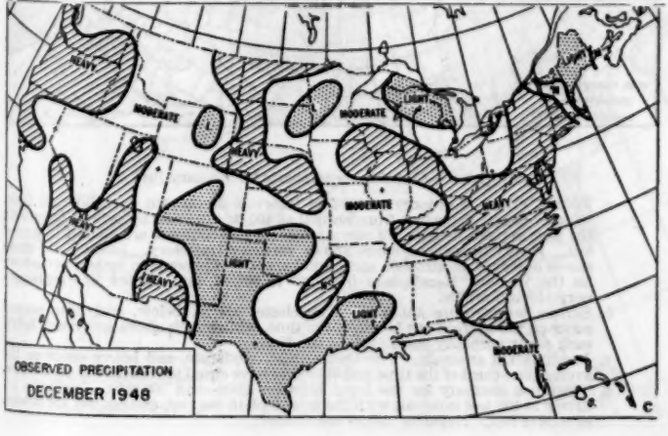


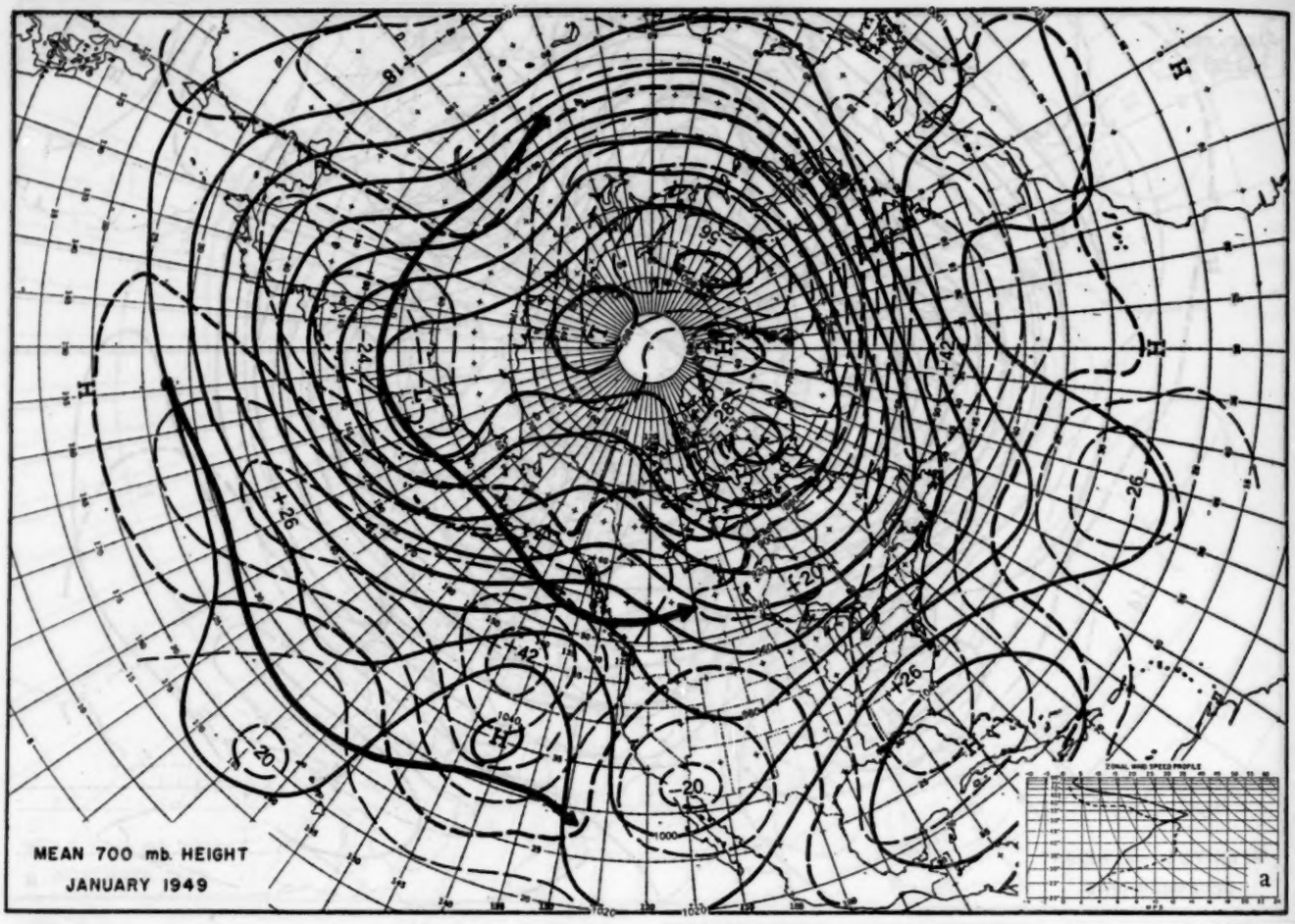
FIGURE 8.—Monthly mean charts for December 1948.

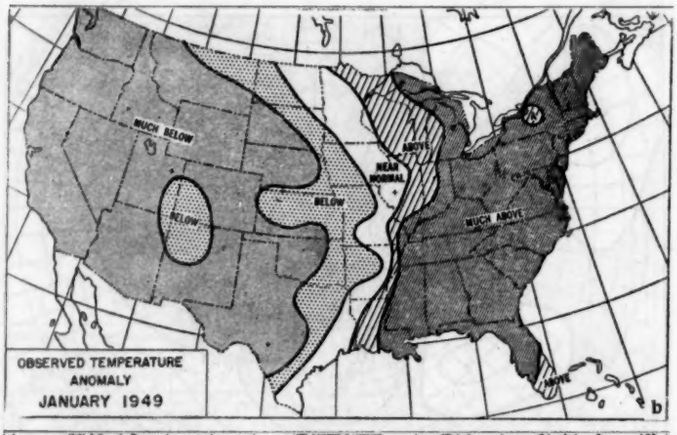
a. 700-mb. chart. Contours at 200-foot intervals are shown by solid thin lines, 700-mb. height departure from normal at 100-foot intervals by dashed lines with the zero isopleth heavier. Anomaly centers and contours are labeled in tens of feet. Heavy arrowhead curve shows vorticity trajectory. Inset: Solid curve shows observed geostrophic zonal wind speed components in meters per second for the Western Hemisphere from 20° to 90° N. latitude; dashed line represents normal wind profile.

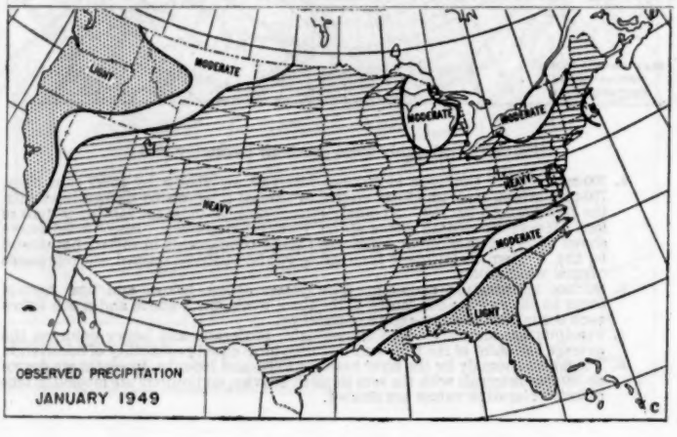
b. Surface temperature anomaly. The classes above, below, and near normal occur on the average one-fourth of the time, while much above and much below each occur normally one-eighth of the time.

c. Precipitation anomaly. The classes light, moderate, and heavy occur on the average one-third of the time and therefore have equal probability of occurrence.

d. Thickness anomaly for the layer between 1,000- and 700-mbs. Isopleths are drawn at 100-foot intervals with the zero isopleth heavier, and centers are labeled in tens of feet. Negative values are shaded.







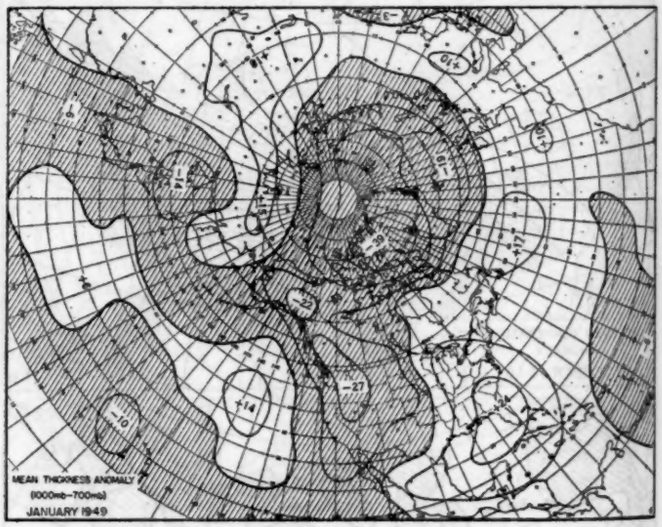


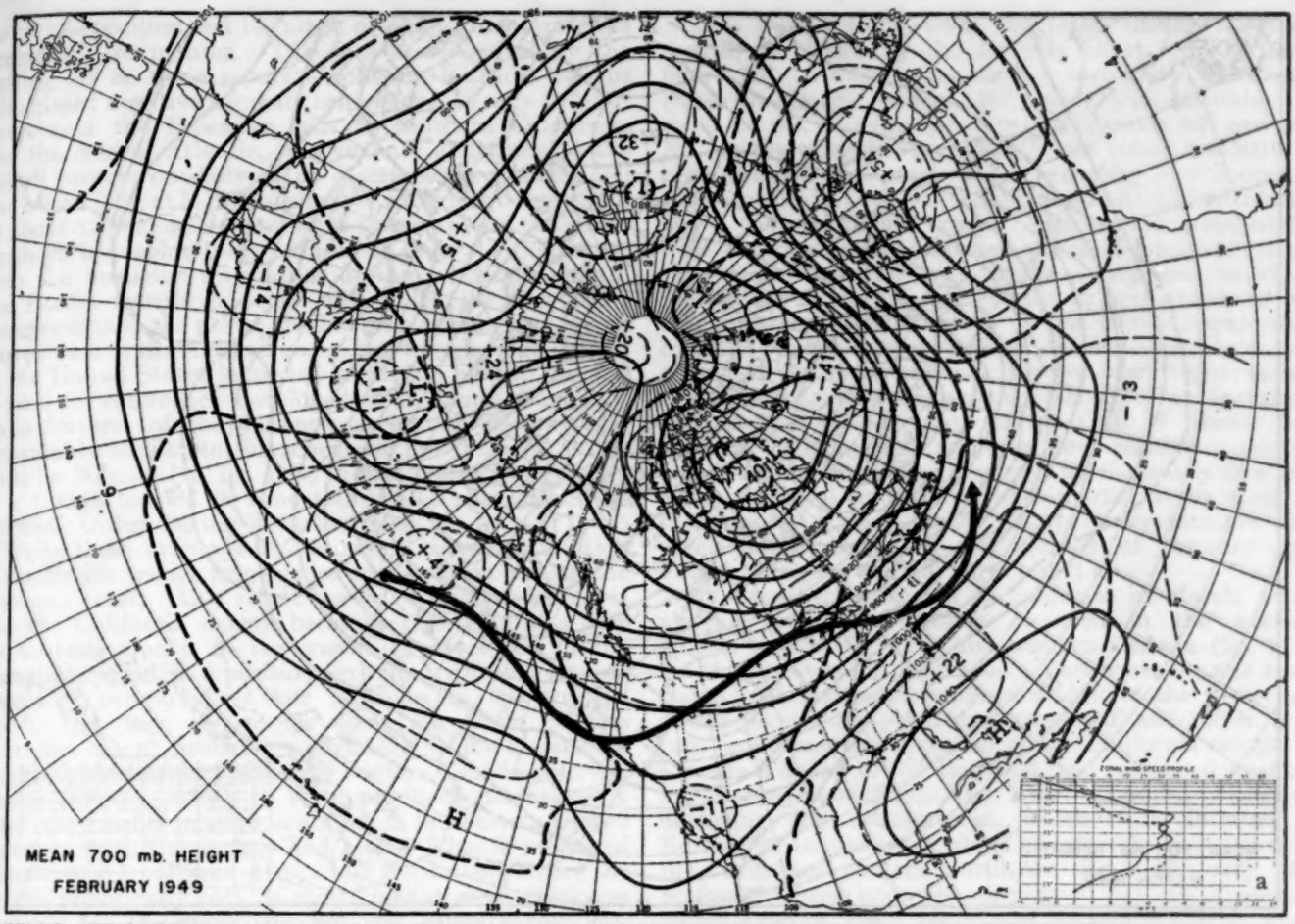
FIGURE 9.—Monthly mean charts for January 1949.

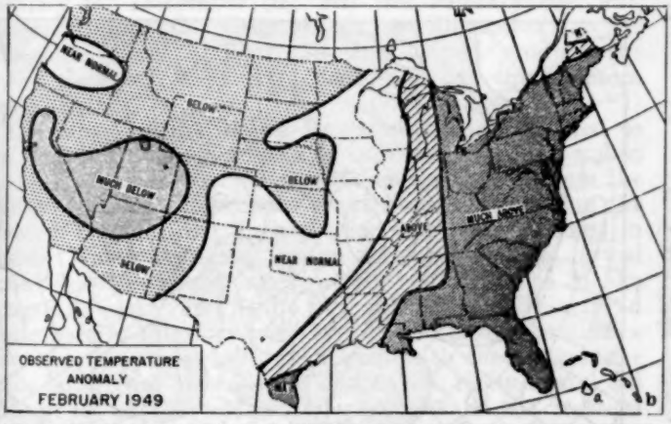
a. 700-mb. chart. Contours at 200-foot intervals are shown by solid thin lines. 700-mb. height departure from normal at 100-ft. intervals by dashed lines with the zero isopleth heavier. Anomaly centers and contours are labeled in tens of feet. Heavy arrowhead curve shows vorticity trajectory. Inset: Solid curve shows observed geostrophic zonal wind speed components in meters per second for the Western Hemisphere from 20° to 90° N. lat.; dashed line represents normal wind profile.

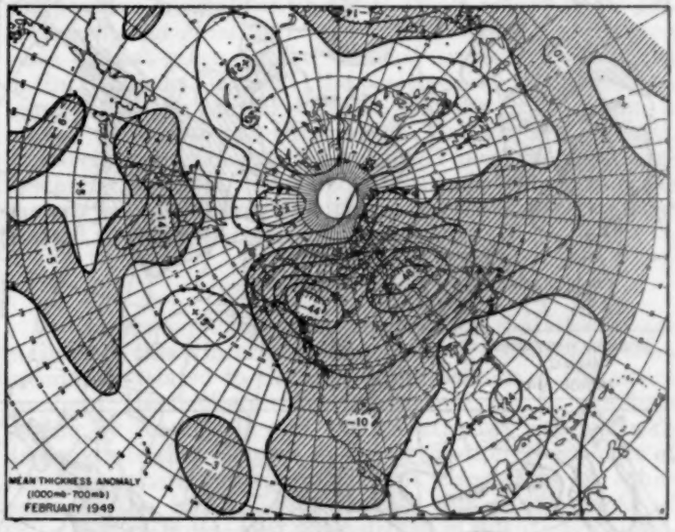
b. Surface temperature anomaly. The classes above, below, and near normal occur on the average one-fourth of the time, while much above and much below each occur normally one-eighth of the time.

c. Precipitation anomaly. The classes light, moderate, and heavy occur on the average one-third of the time and therefore have equal probability of occurrence.

d. Thickness anomaly for the layer between 1,000- and 700-mbs. Isopleths are drawn at 100-foot intervals with the zero isopleth heavier, and centers are labeled in tens of feet. Negative values are shaded.







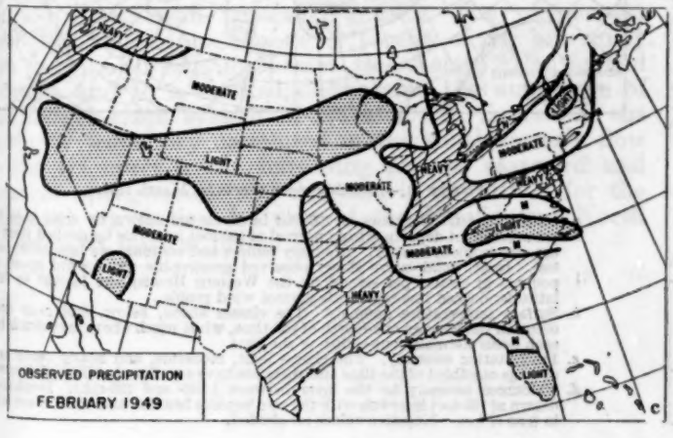


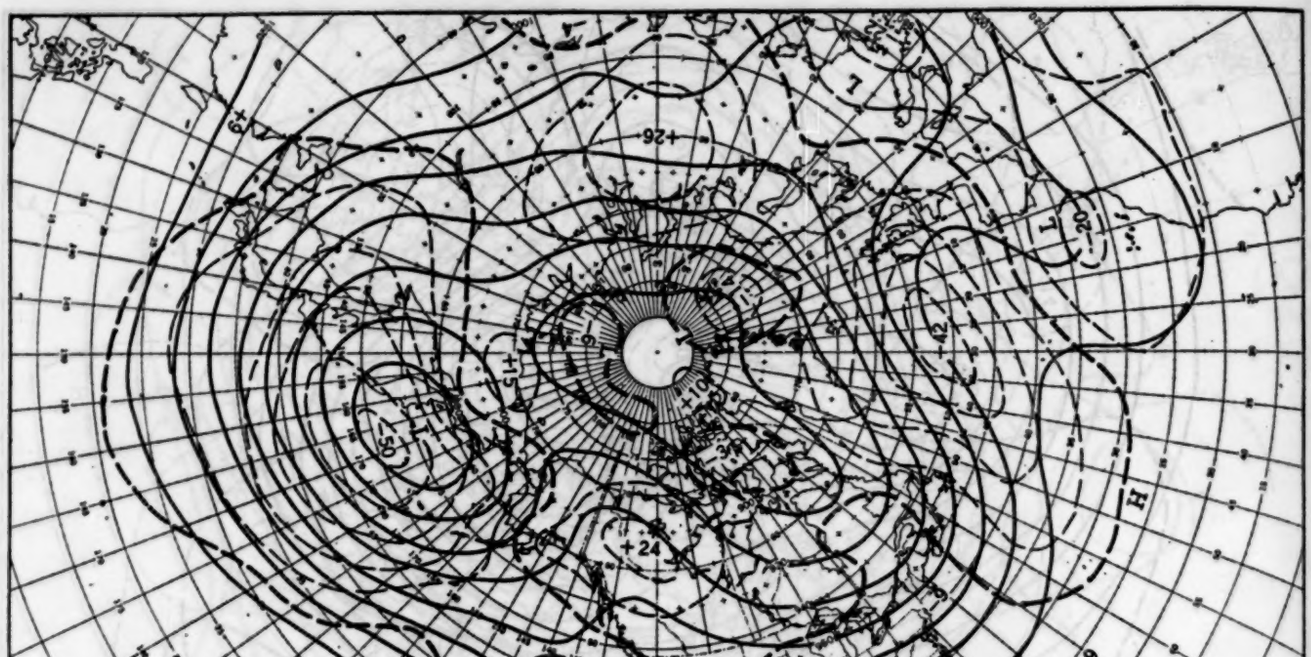
FIGURE 10.—Monthly mean charts for February 1949.

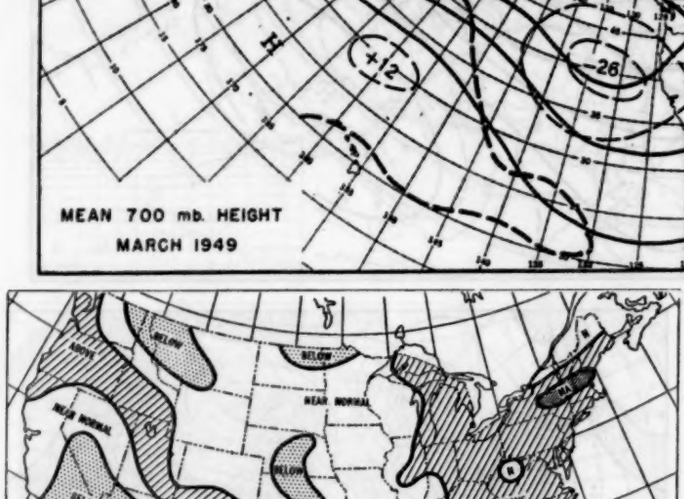
a. 700-mb. chart. Contours at 200-feet intervals are shown by solid thin lines, 700-mb. height departure from normal at 100-foot intervals by dashed lines with the zero isopleth heavier. Anomaly centers and contours are labeled in tens of feet. Heavy arrowhead curve shows vorticity trajectory. Inset: Solid curve shows observed geostrophic zonal wind speed components in meters per second for the Western Hemisphere from 20° to 90° N. latitude; dashed line represents normal wind profile.

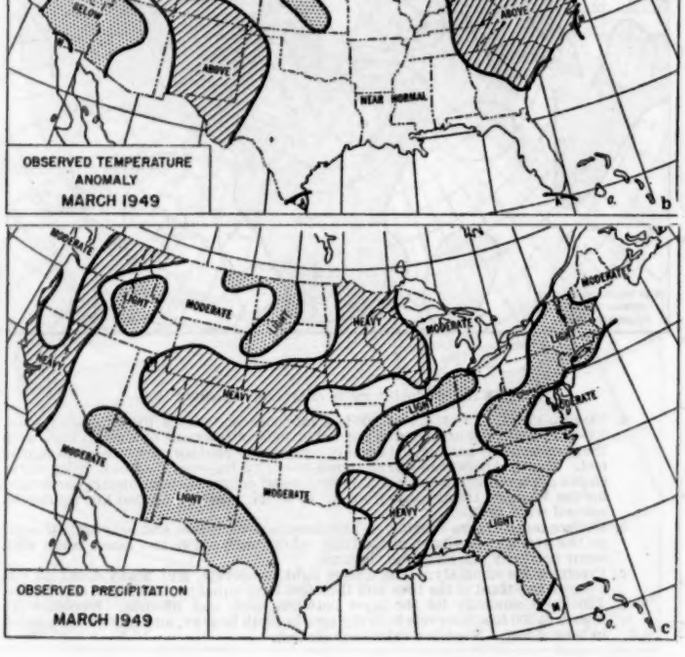
b. Surface temperature anomaly. The classes above, below, and near normal occur on the average one-fourth of the time, while much above and much below each occur normally one-eighth of the time.

c. Precipitation anomaly. The classes light, moderate, and heavy occur on the average one-third of the time and therefore have equal probability of occurrence.

d. Thickness anomaly for the layer between 1,000- and 700-mbs. Isopleths are drawn at 100-foot intervals with the zero isopleth heavier, and centers are labeled in tens of feet. Negative values are shaded.







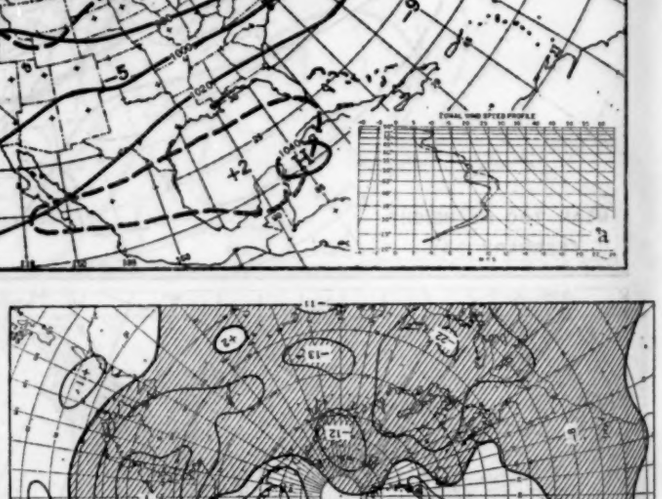


FIGURE 11.—Monthly mean charts for March 1949.

a. 700-mb. chart. Contours at 200-foot intervals are shown by solid thin lines; 700-mb. height departure from normal at 100-foot intervals by dashed lines with the zero isopleth heavier. Anomaly centers and contours are labeled in tens of feet. Inset: Solid curve shows observed geostrophic zonal wind speed components in meters per second for the Western Hemisphere for 20° to 90° N. latitude; dashed line represents normal wind profile.

b. Surface temperature anomaly. The classes above, below, and near normal occur on the average one-fourth of the time, while much above and much below each occur normally one-eighth of the time.

c. Precipitation anomaly. The classes light, moderate, and heavy occur on the average one-third of the time and therefore have equal probability of occurrence.

d. Thickness anomaly for the layer between 1,000- and 700-mbs. Isopleths are drawn at 100-foot intervals with the zero isopleth heavier, and centers are labeled in tens of feet. Negative values are shaded.

its normal position and 10° north of its position during the preceding two months. This was accompanied by the cutting off of three separate cold low-latitude troughs with closed negative anomaly centers spaced only 50°–70° apart near the Hawaiian Islands, southern California, and the central Atlantic, in a manner analogous to the cut-off process on daily maps described by Palmén [25] and others [22]; at high latitudes the wave length increased to about 120° and the number of waves around the entire northern hemisphere was reduced to only 3. Consistent with the vorticity trajectories of the preceding month, the Pacific trough deepened and ended its long-period retrogression in the north, the Pacific ridge intensified and moved east to the Alaskan coast, the trough-ridge system in the United States increased greatly in amplitude, and a zone of confluence developed near James Bay. All these features of the January circulation patterns are remarkably similar to the schematic flow pattern postulated by Namias [15, fig. 11B] to follow strong deepening of a trough located in almost the same position as the Eurasian trough during December 1948.

While these events were occurring, the lower portion of the Pacific trough retrograded to a position just off the Japanese coast. As a result the wave length between it and the California trough became excessive and a new low-latitude trough in the westerlies developed in the Hawaiian region, in a position agreeing with the vorticity trajectory computed at low latitudes in the western Pacific (fig. 9a). Warm air advection ahead of this Hawaiian trough probably contributed to the increase of heights in the eastern Pacific and western Canada observed during January, which in turn, produced northeasterly wind components relative to normal in the western United States at both the surface and aloft. This flow steered polar anticyclones from Alaska and the Yukon, where the air was abnormally cold, as shown by the mean thickness anomaly for December (fig. 8d) and January (fig. 9d), southward into the Great Basin, as illustrated by the anticyclone track of figure 3b, and helped produce the severe January weather experienced by the western United States.

The development of the Hawaiian trough also led to the establishment of a zone of confluence in January in the Gulf of Alaska between warm southerly flow from the Hawaiian Islands and cooler southwesterly flow from the western Pacific. Confluence was even more marked in eastern North America, where the cyclonically curved northwesterly current was bringing cold air from Alaska alongside warm air from the anticyclonically curved southwesterly flow from Mexico. These confluence processes may have been associated with the appearance of the jet stream between 50° and 55° N. latitude and the cutting off of the low-latitude troughs in the western United States and central Atlantic. They were also probably related to the development of an extremely fast band of westerlies across the North Atlantic and Eurasia and to a marked decrease in the amplitude of the trough-ridge system in Eurasia. In figure 9a, the vorticity trajectory computed in the southwesterly flow in Siberia spreads the flattening process eastward and denotes retrogression and decrease in amplitude for the principal circulation features of the Pacific and North America, at least at higher latitudes.

This is essentially what happened during the next month, as shown by the 700-mb. chart for February, figure 10a. At the same time a secondary jet stream began to emerge between 40° and 45° N. latitude, 10° south of the decaying primary jet between 50° and 55° N. As the westerlies spread south the closed low-latitude lows (relative to normal) of the preceding month opened to the north in both the Atlantic and the United States, while the Hawaiian trough disappeared completely. This trough disappearance left an excessive wave length across the Pacific at low latitudes, in response to which the California trough also began to retrograde, in accordance with the indication of the vorticity trajectory computed in the central Pacific on the February chart. As a result of flattening and retrogression, cyclonic curvature and below-normal heights replaced anticyclonic curvature and above-normal heights in the Gulf of Alaska and western Canada, and westerly flow relative-to-normal and maritime conditions replaced northeasterly flow relative-to-normal and continental conditions in most of the western United States (compare temperature and precipitation anomalies for months of January and February, figs. 9 and 10, parts b and c).

The weather continued to moderate in March, when above-normal temperatures occurred in the western United States (fig. 11b) and western Canada (fig. 11d) for the first time in 5 months. This warming was associated with continued southward shift of the westerlies, with a jet stream appearing between 30° and 35° N. latitude, continued retrogression of the California trough to a position about 10° off the coast, and continued weakening of the Pacific ridge (fig. 11a). These processes of flattening and retrogression, which were initiated in Eurasia in January and which affected the circulation in the Pacific and western North America in February, had profound effects upon the circulation pattern of eastern North America, the Atlantic, and Eurasia in March, when the positive anomaly in the East Coast ridge almost disappeared, the Atlantic trough retrograded to a position close to that given by the vorticity trajectory computed in the Pacific in February, the positive anomaly in Europe appeared in the central Atlantic, and the Russian trough moved west from the Urals to the Balkans and Poland. These changes in circulation produced lower heights, more northerly flow, and cooler temperatures in Europe and the eastern United States, and the weather returned to near normal in many parts of the world.

CONCLUSION

In conclusion it should be emphasized that the abnormalities of this winter's weather in the United States were intimately related to the circulation pattern of the entire northern Hemisphere. In this article, as in previous papers by Namias [1 and 15], an attempt was made to demonstrate that changes in the circulation in one part of the hemisphere greatly affect the circulation in other parts of the hemisphere. During this winter most of these changes proceeded downstream in qualitative agreement with simple wave length and vorticity principles;[4] in other years they appeared to be transmitted in a much

[4] An empirical study of the applicability of wave length and vorticity considerations to the 700-mb. monthly mean maps observed during the last 15 years is now being conducted as a research project of the Extended Forecast Section, U. S. Weather Bureau.

more complicated fashion and occasionally in an upstream direction through blocking action (Namias [15]; Elliot and Smith [26]). It was previously shown (Namias and Clapp [18]; Klein and Winston [27]; Hess and Wagner [28]) that energy is frequently transferred downstream at a rate considerably greater than the speed of individual air particles. In this paper evidence was presented that the effects of circulation changes on monthly mean maps may sometimes be transmitted downstream much more slowly than the speed of individual air particles. A similar phenomenon was recently noted by Elliott and Smith [26] for blocking cases studied with three-day mean maps. These processes of non-advective transport or dispersion of energy were discussed theoretically for simple atmospheric models with the aid of the group velocity concept by Rossby [29] and Yeh [30]. A complete explanation of the complex mechanism by means of which large-scale disturbances are intiated and transmitted in the observed atmosphere will probably require many more years of study of the circulation itself and of extra-terrestrial influences as well.

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METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR APRIL 1949

AEROLOGICAL OBSERVATIONS

[For description of change in Table 1 and charts, see REVIEW, January 1946, p. 6]

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during April 1949*

STATIONS AND MEAN SURFACE PRESSURES

Standard pressure surface (mb.)	Albany, N. Y. (1,002.4 mb.)				Albuquerque, N. Mex. (836.3 mb.)				Atlanta, Ga. (981.4 mb.)				Big Spring, Tex. (926.5 mb.)				Bismarck, N. Dak. (954.6 mb.)				Boise, Idaho (915.3 mb.)				Brownsville, Tex. (1,012.4 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	86	7.4	73	30	1,620	14.4	37	30	300	14.7	64	30	774	14.8	59	30	505	9.1	52	30	868	14.3	38	30	6	21.3	83
1,000	30	105	(*)	----	30	77	(*)	----	30	140	(*)	----	30	118	(*)	----	30	114	(*)	----	30	110	(*)	----	30	112	21.1	82
950	30	532	6.4	61	30	530	(*)	----	30	577	14.9	56	30	563	(*)	----	30	547	(*)	----	30	554	(*)	----	30	558	19.0	76
900	30	969	3.6	60	30	997	(*)	----	30	1,031	12.3	56	30	1,020	15.2	55	30	993	8.8	44	30	1,011	15.4	30	30	1,020	17.4	67
850	30	1,431	.7	62	30	1,482	(*)	----	30	1,508	9.9	55	30	1,502	12.5	55	30	1,463	5.4	46	30	1,491	11.5	33	30	1,508	15.7	61
800	30	1,915	−2.1	63	30	1,994	12.6	35	30	2,010	7.7	49	30	2,008	9.9	52	30	1,955	2.2	46	30	1,994	7.4	37	30	2,021	13.3	53
750	30	2,431	−4.5	61	30	2,539	8.4	38	30	2,543	5.2	47	29	2,547	6.9	48	30	2,479	−.9	46	30	2,525	3.3	41	30	2,567	10.7	46
700	30	2,966	−7.0	61	30	3,096	3.6	42	30	3,099	2.1	44	29	3,104	3.0	47	30	3,021	−4.0	42	30	3,076	−.7	44	30	3,134	8.1	38
650	30	3,457	−10.0	63	30	3,699	−1.4	48	30	3,696	−1.6	39	29	3,700	−1.1	44	30	3,610	−7.7	39	30	3,666	−5.0	41	30	3,744	3.9	39
600	30	4,154	−13.7	57	30	4,324	−6.6	51	30	4,327	−5.4	36	29	4,334	−5.8	44	30	4,220	−11.8	39	30	4,288	−9.1	39	30	4,386	−1.0	44
550	30	4,811	−17.5	51	29	5,000	−12.2	55	30	5,005	−9.7	38	29	5,009	−10.4	41	30	4,885	−15.6	38	30	4,959	−13.6	40	30	5,072	−6.1	46
500	30	5,517	−22.5	----	29	5,716	−17.3	52	30	5,733	−14.4	38	29	5,738	−15.5	40	29	5,593	−21.1	----	30	5,673	−18.9	39	30	5,813	−11.5	47
450	30	6,290	−27.9	----	28	6,503	−23.0	----	30	6,531	−19.9	38	29	6,531	−21.2	----	29	6,369	−26.8	----	30	6,455	−24.8	----	30	6,618	−17.2	42
400	29	7,125	−33.7	----	26	7,348	−29.8	----	30	7,388	−25.9	----	29	7,385	−27.8	----	28	7,208	−33.2	----	30	7,294	−31.1	----	30	7,496	−23.3	----
350	29	8,047	−40.4	----	26	8,285	−36.8	----	30	8,341	−32.9	----	29	8,330	−34.9	----	26	8,143	−40.4	----	29	8,229	−38.6	----	30	8,450	−30.0	----
300	28	9,078	−47.0	----	26	9,335	−44.3	----	29	9,410	−41.0	----	29	9,388	−42.6	----	25	9,169	−48.5	----	29	9,268	−46.6	----	28	9,524	−38.3	----
250	26	10,263	−52.4	----	23	10,521	−51.8	----	28	10,622	−50.4	----	29	10,597	−50.4	----	24	10,349	−56.2	----	28	10,455	−54.9	----	28	10,753	−47.5	----
200	23	11,700	−52.5	----	22	11,941	−56.7	----	26	12,049	−58.8	----	28	12,028	−56.0	----	17	11,783	−59.1	----	28	11,860	−59.5	----	27	12,200	−56.3	----
175	21	12,555	−51.2	----	18	12,781	−57.7	----	23	12,895	−60.6	----	28	12,874	−57.1	----	12	12,631	−57.1	----	25	12,690	−57.5	----	26	13,041	−59.7	----
150	17	13,562	−51.8	----	13	13,729	−56.0	----	19	13,843	−59.8	----	28	13,848	−57.3	----	8	13,640	−56.8	----	23	13,662	−56.4	----	24	14,005	−61.7	----
125	15	14,737	−53.5	----	9	14,857	−55.2	----	13	14,978	−61.0	----	21	14,996	−59.0	----	6	14,806	−56.2	----	21	14,809	−57.1	----	19	15,127	−64.1	----
100	9	16,157	−55.4	----	6	16,256	−56.3	----	9	16,376	−64.5	----	15	16,385	−61.6	----	----	----	----	----	16	16,208	−57.6	----	7	16,471	−67.8	----
80	----	----	----	----	----	----	----	----	----	----	----	----	6	17,778	−64.2	----	----	----	----	----	11	17,614	−56.9	----	----	----	----	----
60	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5	19,447	−57.2	----	----	----	----	----

Standard pressure surface (mb.)	Buffalo, N. Y. (988.1 mb.)				Camaguey, Cuba [1] (------ mb.)				Caribou, Maine (987.8 mb.)				Charleston, S. C. (1,014.2 mb.)				Ciudad Victoria, Mex. (972.0 mb.)				Columbia, Mo. (987.1 mb.)				Dodge City, Kans. (925.0 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	221	5.6	71	----	----	----	----	30	191	2.6	78	30	13	16.1	82	27	335	25.2	53	30	239	11.0	64	30	792	10.6	67
1,000	30	122	(*)	----	----	----	----	----	30	90	(*)	----	30	133	17.2	73	27	83	(*)	----	30	129	(*)	----	30	132	(*)	----
950	30	545	5.9	58	----	----	----	----	30	510	2.6	66	30	574	15.9	63	27	537	23.5	54	30	564	11.4	54	30	567	(*)	----
900	30	983	3.4	59	----	----	----	----	30	943	.2	66	30	1,028	13.1	62	27	1,004	19.7	60	30	1,009	8.4	57	30	1,021	11.7	57
850	30	1,444	.3	61	----	----	----	----	30	1,399	−2.7	69	30	1,507	11.0	54	27	1,494	16.2	65	30	1,478	5.4	56	30	1,497	9.1	56
800	30	1,928	−1.9	59	----	----	----	----	30	1,877	−5.6	67	30	2,012	8.9	48	27	2,008	13.0	70	30	1,972	3.1	57	30	1,997	6.1	55
750	30	2,443	−4.4	60	----	----	----	----	30	2,383	−8.5	64	30	2,549	6.0	46	27	2,550	10.3	71	30	2,498	.8	52	30	2,528	3.3	55
700	30	2,980	−7.2	54	----	----	----	----	30	2,914	−10.7	58	30	3,106	2.8	42	27	3,121	8.3	58	30	3,045	−1.4	46	30	3,079	.1	50
650	30	3,556	−10.4	49	----	----	----	----	30	3,484	−13.8	56	30	3,706	−.8	39	27	3,732	5.0	48	30	3,638	−5.0	45	30	3,672	−3.6	47
600	30	4,166	−14.0	48	----	----	----	----	30	4,084	−17.3	55	30	4,336	−5.0	36	27	4,380	.5	43	30	4,256	−8.7	41	30	4,297	−7.8	41
550	30	4,826	−17.8	43	----	----	----	----	30	4,734	−21.3	----	30	5,018	−9.5	34	26	5,068	−5.0	41	30	4,928	−13.1	38	30	4,968	−12.7	40
500	30	5,529	−22.5	----	----	----	----	----	30	5,428	−25.8	----	30	5,745	−14.1	35	25	5,812	−10.2	38	30	5,645	−18.0	37	29	5,690	−17.7	34
450	30	6,296	−28.0	----	----	----	----	----	30	6,187	−31.1	----	30	6,545	−19.4	37	25	6,627	−15.2	----	30	6,427	−23.9	----	29	6,474	−23.6	----
400	30	7,129	−34.1	----	----	----	----	----	30	7,009	−37.0	----	30	7,404	−25.6	----	25	7,500	−21.1	----	30	7,272	−30.3	----	29	7,319	−30.2	----
350	30	8,050	−40.8	----	----	----	----	----	30	7,920	−43.3	----	30	8,358	−32.5	----	23	8,472	−28.9	----	30	8,207	−37.8	----	28	8,257	−37.5	----
300	30	9,083	−47.2	----	----	----	----	----	27	8,950	−48.7	----	30	9,427	−40.7	----	23	9,555	−37.5	----	29	9,247	−45.6	----	28	9,304	−45.2	----
250	28	10,274	−52.0	----	----	----	----	----	25	10,147	−51.8	----	30	10,643	−50.0	----	23	10,787	−47.7	----	29	10,441	−52.4	----	27	10,497	−53.0	----
200	24	11,709	−52.6	----	----	----	----	----	21	11,603	−51.6	----	28	12,072	−57.9	----	23	12,228	−57.6	----	21	11,872	−55.1	----	26	11,926	−57.6	----
175	17	12,559	−51.4	----	----	----	----	----	16	12,476	−50.7	----	27	12,913	−59.4	----	20	13,070	−62.5	----	14	12,709	−55.4	----	24	12,776	−57.9	----
150	13	13,567	−51.7	----	----	----	----	----	10	13,499	−50.8	----	24	13,872	−60.1	----	12	14,027	−64.2	----	12	13,708	−55.9	----	22	13,767	−57.5	----
125	11	14,737	−52.0	----	----	----	----	----	7	14,664	−50.2	----	24	15,006	−61.4	----	----	----	----	----	7	14,882	−58.1	----	21	14,921	−58.7	----
100	6	16,160	−54.1	----	----	----	----	----	----	----	----	----	18	16,365	−64.1	----	----	----	----	----	5	16,324	−61.5	----	13	16,314	−61.6	----
80	----	----	----	----	----	----	----	----	----	----	----	----	8	17,711	−64.1	----	----	----	----	----	----	----	----	----	8	17,710	−61.7	----

Standard pressure surface (mb.)	El Paso, Tex. (879.6 mb.)				Ely, Nev. (808.4 mb.)				Glasgow, Mont. (937.1 mb.)				Grand Junction, Colo. (851.1 mb.)				Great Falls, Mont. (885.6 mb.)				Greensboro, N. C. (983.6 mb.)				Hatteras, N. C. (1,015.4 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	1,195	17.7	31	30	1,908	9.0	42	30	648	12.1	32	30	1,474	12.5	47	30	1,128	11.5	37	30	273	11.9	69	30	3	15.2	77
1,000	30	80	(*)	----	30	99	(*)	----	30	94	(*)	----	30	93	(*)	----	30	94	(*)	--	30	133	(*)	----	30	132	15.1	72
950	30	534	(*)	----	30	543	(*)	----	30	534	(*)	----	30	540	(*)	----	30	540	(*)	----	30	564	12.9	53	30	568	13.3	62
900	30	1,003	(*)	----	30	1,007	(*)	----	30	985	12.7	28	30	1,003	(*)	----	30	1,000	(*)	----	30	1,017	10.2	53	30	1,019	10.8	55
850	30	1,487	17.0	31	30	1,487	(*)	----	30	1,463	8.9	33	30	1,484	(*)	----	30	1,470	10.3	33	30	1,490	7.3	55	30	1,493	8.2	55
800	30	2,000	13.1	32	30	1,995	10.8	33	30	1,960	4.8	38	30	1,994	11.8	36	30	1,970	6.3	38	30	1,986	4.8	51	30	1,991	5.4	54
750	30	2,543	8.9	33	30	2,534	7.5	32	30	2,484	.6	43	30	2,532	7.4	41	30	2,498	1.9	42	30	2,516	2.5	46	30	2,521	3.1	50
700	30	3,105	4.6	35	30	3,093	2.7	37	30	3,032	−3.5	45	30	3,093	2.7	46	30	3,047	−2.3	43	30	3,065	−.3	42	29	3,074	.4	42
650	30	3,704	−.4	38	30	3,691	−2.4	42	30	3,615	−7.6	47	30	3,688	−2.1	49	30	3,635	−6.7	44	30	3,656	−3.7	40	28	3,664	−3.2	39
600	30	4,337	−5.4	41	30	4,316	−7.4	44	30	4,232	−11.7	47	30	4,318	−7.1	51	30	4,251	−11.3	47	30	4,281	−7.4	----	28	4,290	−6.8	42
550	30	5,015	−10.7	40	30	4,989	−12.4	42	30	4,893	−16.2	45	30	4,991	−12.0	47	30	4,915	−16.0	46	30	4,952	−11.7	----	28	4,965	−11.0	43
500	29	5,738	−16.2	34	30	5,708	−17.7	38	30	5,604	−21.2	----	30	5,712	−17.2	44	30	5,623	−21.3	----	30	5,677	−16.3	----	28	5,689	−15.8	44
450	29	6,530	−22.2	----	30	6,491	−23.4	----	30	6,380	−26.9	----	30	6,498	−22.8	----	29	6,398	−26.7	----	30	6,465	−21.7	----	28	6,481	−21.1	----
400	29	7,379	−28.0	----	30	7,338	−30.2	----	30	7,212	−33.3	----	30	7,345	−29.4	----	29	7,230	−33.1	----	30	7,320	−28.0	----	28	7,335	−27.2	----
350	29	8,324	−35.1	----	30	8,272	−37.7	----	30	8,136	−40.4	----	30	8,282	−36.8	----	29	8,153	−40.5	----	29	8,269	−34.9	----	27	8,281	−34.2	----
300	29	9,382	−42.5	----	28	9,310	−46.0	----	30	9,168	−48.4	----	28	9,327	−45.4	----	29	9,186	−48.3	----	29	9,326	−42.5	----	26	9,338	−41.5	----
250	28	10,588	−50.4	----	26	10,504	−54.2	----	29	10,339	−56.0	----	26	10,525	−53.2	----	30	10,365	−55.6	----	29	10,535	−50.4	----	26	10,551	−49.9	----
200	27	12,021	−56.9	----	21	11,898	−59.4	----	22	11,758	−57.9	----	20	11,962	−58.8	----	27	11,771	−58.7	----	24	11,975	−56.8	----	25	11,986	−56.6	----
175	26	12,865	−58.2	----	18	12,723	−57.8	----	22	12,604	−55.2	----	16	12,829	−58.6	----	24	12,608	−56.2	----	20	12,833	−57.1	----	23	12,836	−57.9	----
150	23	13,814	−57.9	----	12	13,679	−55.5	----	20	13,579	−53.9	----	14	13,797	−57.0	----	23	13,589	−55.1	----	15	13,821	−57.1	----	18	13,816	−58.5	----
125	18	14,965	−60.0	----	8	14,818	−56.1	----	18	14,748	−54.6	----	11	14,948	−56.4	----	19	14,749	−55.4	----	----	----	----	----	12	14,979	−59.6	----
100	14	16,347	−63.5	----	5	16,237	−56.8	----	15	16,170	−55.2	----	5	16,355	−59.0	----	15	16,167	−56.2	----	----	----	----	----	9	16,383	−62.1	----
80	6	17,663	−63.6	----	----	----	----	----	11	17,602	−55.2	----	----	----	----	----	7	17,582	−55.3	----	----	----	----	----	----	----	----	----
60	----	----	----	----	----	----	----	----	6	19,440	−55.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
50	----	----	----	----	----	----	----	----	5	20,580	−55.9	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

See footnotes at end of table.

839165—49——2

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during April 1949*—Continued

STATIONS AND MEAN SURFACE PRESSURES

Standard pressure surface (mb.)	Havana, Cuba [1] (------ mb.)				Honolulu, T. H. (1,018.2 mb.)				International Falls, Minn. (972.0 mb.)				Joliet, Ill. (994.5 mb.)				Lake Charles, La. (1,014.6 mb.)				Lander, Wyo. (828.2 mb.)				Las Vegas, Nev. (935.4 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface					30	3	24.2	60	30	360	4.3	66	30	178	6.5	71	30	5	17.7	84	30	1,096	8.9	46	29	660	20.4	28
1,000					30	161	21.7	63	30	126	(*)	----	30	131	(*)	----	30	129	18.0	75	30	98	(*)	----	29	76	(*)	----
950					30	604	17.9	72	30	549	5.8	59	30	560	8.0	53	30	570	16.2	69	30	544	(*)	----	29	523	(*)	----
900					30	1,064	14.3	80	30	989	3.4	59	30	999	5.4	52	30	1,025	14.4	59	30	1,001	(*)	----	29	994	21.2	22
850					30	1,545	11.6	73	30	1,450	.4	60	30	1,464	2.9	48	30	1,508	12.2	54	30	1,478	(*)	----	29	1,484	17.0	24
800					30	2,051	11.0	47	30	1,934	−2.3	56	30	1,952	.6	44	30	2,014	9.9	49	30	1,984	9.9	37	29	1,996	12.5	28
750					30	2,595	10.0	24	30	2,450	−4.7	52	30	2,478	−1.6	43	30	2,553	6.9	51	30	2,518	5.6	39	28	2,536	7.7	23
700					30	3,159	7.2	24	30	2,984	−7.4	49	30	3,015	−4.2	43	30	3,111	3.5	49	30	3,075	1.0	43	28	3,094	2.9	23
650					30	3,769	3.6	----	30	3,563	−10.3	49	30	3,602	−7.7	42	30	3,710	−.2	48	30	3,670	−4.1	48	28	3,690	−2.0	23
600					30	4,409	−.3	----	30	4,169	−13.9	50	30	4,213	−11.5	39	30	4,346	−4.4	51	30	4,291	−8.8	50	28	4,319	−6.7	23
550					30	5,099	−4.9	----	30	4,828	−18.4	50	30	4,877	−16.1	36	29	5,027	−8.8	49	30	4,962	−13.7	47	28	4,994	−11.5	23
500					30	5,842	−10.3	----	29	5,530	−23.5	----	29	5,580	−21.2	----	28	5,756	−14.3	44	30	5,677	−19.1	42	28	5,716	−16.9	----
450					30	6,654	−16.4	----	28	6,296	−28.8	----	29	6,356	−26.7	----	28	6,555	−19.8	36	30	6,459	−25.0	----	28	6,500	−23.1	----
400					30	7,520	−22.8	----	28	7,123	−34.9	----	29	7,189	−33.0	----	28	7,412	−26.0	----	30	7,297	−31.5	----	28	7,348	−30.1	----
350					30	8,484	−30.6	----	28	8,040	−41.7	----	29	8,115	−39.6	----	28	8,364	−33.2	----	30	8,228	−38.9	----	28	8,283	−37.6	----
300					30	9,559	−39.3	----	26	9,064	−48.7	----	29	9,154	−46.4	----	27	9,428	−41.3	----	30	9,265	−47.6	----	28	9,329	−45.1	----
250					30	10,783	−48.6	----	22	10,259	−54.5	----	29	10,346	−52.6	----	26	10,637	−50.5	----	30	10,444	−55.8	----	28	10,524	−53.0	----
200					30	12,219	−57.4	----	18	11,672	−55.7	----	28	11,771	−54.1	----	23	12,059	−58.9	----	27	11,842	−59.8	----	27	11,939	−58.7	----
175					30	13,054	−61.2	----	9	12,504	−53.5	----	28	12,628	−53.5	----	20	12,893	−60.2	----	22	12,690	−57.7	----	27	12,777	−58.3	----
150					30	14,006	−63.5	----	5	13,487	−52.1	----	24	13,607	−53.7	----	18	13,848	−60.3	----	20	13,673	−56.8	----	26	13,747	−57.9	----
125					30	15,119	−65.7	----					21	14,759	−54.4	----	14	14,976	−62.1	----	15	14,827	−57.7	----	25	14,891	−59.7	----
100					29	16,467	−68.4	----					14	16,162	−55.6	----	10	16,341	−65.9	----	8	16,230	−58.1	----	20	16,283	−61.5	----
80					27	17,799	−68.7	----					10	17,605	−57.1	----									11	17,650	−62.3	----
60					26	19,546	−62.1	----																				
50					25	20,679	−59.6	----																				
40					22	22,085	−56.0	----																				
30					15	23,921	−52.0	----																				
20					5	26,555	−48.2	----																				

Standard pressure surface (mb.)	Little Rock, Ark. (1,005.9 mb.)				Mazatlan, Mex. (1,009.1 mb.)				Medford, Oreg. (970.0 mb.)				Merida, Mex. (1,009.3 mb.)				Miami, Fla. (1,016.6 mb.)				Nantucket, Mass. (1,011.7 mb.)				Nashville, Tenn. (994.4 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	79	15.8	64	18	14	22.2	75	30	401	15.1	52	30	27	27.5	64	30	4	23.1	77	30	14	6.4	85	30	177	13.9	66
1,000	30	129	16.2	61	18	93	21.6	72	30	141	(*)	----	30	109	26.8	65	30	148	22.8	75	30	110	7.5	77	30	130	(*)	----
950	30	566	14.7	57	18	539	21.0	45	30	581	15.9	42	30	564	24.7	64	30	599	20.4	72	30	537	7.1	61	30	563	13.0	57
900	30	1,020	11.9	60	18	1,004	19.9	34	30	1,034	12.5	46	30	1,034	21.6	66	30	1,059	17.5	71	30	976	4.7	60	30	1,014	10.0	60
850	30	1,496	9.4	58	18	1,494	17.2	----	30	1,510	8.6	52	30	1,528	18.6	67	30	1,546	14.9	61	30	1,439	1.9	59	30	1,487	7.2	61
800	30	1,997	7.2	55	17	2,008	14.2	----	30	2,008	4.8	56	30	2,046	15.2	68	30	2,057	12.2	57	30	1,926	−.7	60	30	1,984	5.0	54
750	30	2,530	4.4	47	17	2,555	11.1	----	30	2,537	1.3	51	30	2,593	12.2	60	30	2,602	9.4	48	30	2,439	−3.3	55	30	2,511	2.4	42
700	30	3,084	.8	45	17	3,121	7.7	----	30	3,084	−2.0	49	30	3,167	9.7	45	28	3,164	6.7	42	30	2,982	−5.8	51	30	3,063	−.8	50
650	30	3,677	−3.2	48	17	3,732	4.2	----	30	3,674	−5.6	45	30	3,780	6.3	38	28	3,774	3.3	36	30	3,564	−8.6	48	30	3,653	−4.4	45
600	30	4,304	−7.1	47	17	4,375	.5	----	30	4,293	−9.1	40	30	4,429	2.2	32	28	4,412	−.5	33	30	4,177	−12.1	45	30	4,277	−8.3	45
550	30	4,977	−11.5	47	17	5,069	−3.8	----	30	4,962	−13.3	40	30	5,124	−2.3	27	28	5,105	−4.5	30	30	4,839	−16.4	42	30	4,947	−12.5	41
500	30	5,702	−16.1	40	17	5,813	−8.8	----	30	5,679	−18.2	41	30	5,875	−7.0	----	28	5,847	−9.3	31	30	5,547	−21.1	----	30	5,668	−17.3	40
450	30	6,490	−21.7	----	17	6,629	−14.4	----	29	6,458	−24.1	----	30	6,696	−12.9	----	28	6,662	−15.3	33	30	6,321	−26.6	----	29	6,451	−22.8	----
400	29	7,346	−28.0	----	16	7,503	−20.8	----	29	7,302	−30.8	----	30	7,576	−19.3	----	28	7,532	−21.7	----	30	7,157	−32.9	----	29	7,300	−28.8	----
350	28	8,298	−35.2	----	16	8,475	−28.1	----	29	8,236	−38.0	----	30	8,553	−27.0	----	28	8,501	−29.2	----	30	8,083	−39.5	----	29	8,243	−35.4	----
300	28	9,354	−43.0	----	16	9,563	−36.5	----	28	9,280	−46.1	----	30	9,643	−35.6	----	28	9,583	−37.6	----	30	9,121	−46.6	----	28	9,302	−43.0	----
250	27	10,570	−50.7	----	16	10,800	−46.6	----	28	10,469	−54.4	----	30	10,884	−45.4	----	28	10,815	−47.1	----	29	10,315	−51.5	----	27	10,512	−51.3	----
200	22	12,016	−57.8	----	16	12,244	−57.5	----	28	11,876	−60.2	----	29	12,333	−57.0	----	27	12,259	−57.2	----	26	11,753	−53.4	----	25	11,934	−57.4	----
175	20	12,854	−57.8	----	16	13,078	−61.4	----	25	12,708	−58.1	----	29	13,166	−62.5	----	24	13,093	−61.8	----	24	12,603	−52.9	----	23	12,780	−57.6	----
150	17	13,823	−58.0	----	15	14,025	−64.2	----	21	13,674	−56.3	----	27	14,108	−67.3	----	20	14,041	−64.5	----	21	13,644	−52.9	----	21	13,757	−57.1	----
125	12	14,958	−59.7	----	14	15,128	−67.1	----	14	14,832	−57.1	----	25	15,190	−71.4	----	15	15,140	−65.9	----	16	14,749	−53.9	----	20	14,913	−58.7	----
100					12	16,459	−70.0	----	10	16,252	−57.3	----	15	16,498	−75.3	----	8	16,471	−69.9	----	11	16,176	−55.1	----	12	16,329	−61.8	----
80					9	17,792	−72.2	----					6	17,801	−77.2	----												

Standard pressure surface (mb.)	New Orleans, La. (1,015.4 mb.)				North Platte, Nebr. (917.7 mb.)				Oakland, Calif. (1,016.9 mb.)				Oklahoma City, Okla. (962.7 mb.)				Omaha, Nebr. (978.8 mb.)				Phoenix, Ariz. (971.1 mb.)				Pittsburgh, Pa. (969.9 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	2	17.8	84	30	849	8.8	68	30	6	13.6	72	30	391	14.4	62	30	308	12.6	56	30	339	22.4	32	30	382	8.2	63
1,000	30	133	18.8	77	30	126	(*)	----	30	147	13.1	70	30	128	(*)	----	30	136	(*)	----	30	81	(*)	----	30	127	(*)	----
950	30	578	16.7	69	30	568	(*)	----	30	583	13.1	59	30	565	15.0	56	30	569	11.6	45	30	534	24.6	23	30	558	8.2	59
900	30	1,032	14.5	62	30	1,010	10.5	55	30	1,033	12.7	41	30	1,020	12.1	57	30	1,016	8.6	49	30	1,000	21.0	23	30	997	5.5	56
850	30	1,514	12.3	57	30	1,484	7.7	52	30	1,510	10.5	34	30	1,496	9.0	59	30	1,486	5.3	53	30	1,490	16.8	25	30	1,462	2.9	55
800	30	2,020	10.3	49	30	1,981	4.6	53	30	2,012	7.8	31	30	1,998	6.6	53	30	1,978	2.6	46	30	2,002	12.3	28	30	1,951	.0	54
750	29	2,560	7.4	48	30	2,511	1.6	51	30	2,543	4.6	33	30	2,529	4.4	48	30	2,506	.1	41	30	2,546	7.7	32	30	2,471	−2.5	53
700	28	3,121	4.1	47	30	3,058	−1.3	49	30	3,100	1.0	34	30	3,082	1.0	47	30	3,048	−2.7	40	30	3,101	2.9	38	30	3,010	−5.2	49
650	28	3,722	.3	50	30	3,648	−5.0	48	30	3,692	−2.4	29	30	3,676	−3.0	46	30	3,638	−6.2	40	30	3,701	−1.9	37	30	3,596	−8.4	45
600	27	4,357	−3.9	50	30	4,269	−9.1	46	30	4,322	−6.5	31	30	4,303	−7.0	44	30	4,254	−9.8	38	30	4,327	−6.3	36	30	4,206	−12.0	49
550	27	5,040	−8.4	45	30	4,939	−13.7	45	30	4,994	−11.1	34	30	4,978	−11.9	40	30	4,924	−14.3	40	30	5,006	−11.2	35	30	4,870	−16.3	39
500	27	5,771	−13.0	40	30	5,654	−18.9	45	30	5,720	−16.5	37	30	5,698	−17.2	38	30	5,636	−19.4	41	30	5,726	−16.7	36	30	5,576	−21.4	----
450	27	6,574	−18.3	39	30	6,437	−24.7	----	30	6,509	−22.4	----	30	6,485	−22.8	----	30	6,418	−25.0	----	30	6,517	−22.4	----	30	6,353	−26.8	----
400	27	7,436	−25.0	----	30	7,275	−31.2	----	30	7,357	−29.4	----	30	7,333	−29.3	----	30	7,256	−31.4	----	29	7,357	−29.3	----	30	7,185	−32.7	----
350	25	8,390	−32.4	----	30	8,206	−38.8	----	30	8,295	−36.9	----	30	8,272	−36.7	----	30	8,187	−38.9	----	29	8,304	−36.4	----	30	8,113	−38.8	----
300	25	9,460	−40.1	----	30	9,244	−47.3	----	30	9,344	−45.9	----	29	9,315	−44.5	----	30	9,226	−47.2	----	29	9,348	−43.8	----	29	9,164	−45.3	----
250	24	10,679	−49.7	----	29	10,425	−55.4	----	29	10,534	−54.0	----	29	10,513	−52.5	----	30	10,410	−55.0	----	27	10,557	−51.7	----	26	10,375	−50.6	----
200	22	12,122	−58.5	----	27	11,829	−58.9	----	29	11,942	−60.2	----	23	11,917	−56.5	----	25	11,833	−57.8	----	27	11,979	−57.7	----	23	11,822	−53.6	----
175	20	12,966	−61.2	----	24	12,665	−57.0	----	27	12,764	−59.2	----	20	12,766	−57.1	----	19	12,698	−56.3	----	23	12,820	−57.9	----	19	12,683	−54.1	----
150	19	13,914	−61.5	----	20	13,652	−57.1	----	27	13,733	−58.1	----	18	13,719	−56.7	----	13	13,686	−55.9	----	23	13,792	−57.8	----	14	13,646	−53.9	----
125	12	15,036	−62.5	----	18	14,808	−58.3	----	26	14,881	−59.0	----	15	14,872	−58.6	----	9	14,846	−57.1	----	22	14,928	−59.9	----	11	14,828	−55.8	----
100	7	16,393	−65.0	----	10	16,211	−60.2	----	20	16,262	−60.0	----	7	16,266	−60.8	----	5	16,289	−59.6	----	19	16,316	−62.3	----	5	16,254	−57.8	----
80									10	17,652	−61.1	----									15	17,695	−63.5	----				
60																					11	19,475	−63.2	----				

See footnotes at end of table.

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during April 1949*—Continued

STATIONS AND MEAN SURFACE PRESSURES

Standard pressure surface (mb.)	Portland, Maine (1,009.4 mb.)				Rapid City, S. Dak. (902.5 mb.)				St. Cloud, Minn. (978.0 mb.)				San Antonio, Tex. (986.8 mb.)				San Juan, P. R. (1,015.8 mb.)				Santa Maria, Calif. (1,008.6 mb.)				Sault Ste. Marie, Mich. (988.6 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	20	5.3	80	30	980	7.7	57	30	317	5.9	69	30	240	16.8	73	30	15	24.3	81	30	71	12.3	80	30	221	2.8	67
1,000	30	97	(*)	----	30	117	(*)	----	30	133	(*)	----	30	125	(*)	----	30	153	23.2	79	30	143	11.6	79	30	127	(*)	----
950	30	520	5.2	59	30	555	(*)	----	30	561	7.6	55	30	569	16.7	66	30	598	19.7	79	30	584	13.4	63	30	550	4.6	51
900	30	956	2.5	60	30	1,003	(*)	----	30	1,000	4.9	52	30	1,024	14.3	67	30	1,063	16.8	75	30	1,029	13.2	47	30	984	3.1	47
850	30	1,415	−.6	61	30	1,477	8.8	43	30	1,463	1.8	57	30	1,506	12.2	63	30	1,549	13.9	74	30	1,509	11.6	40	30	1,445	.6	47
800	30	1,897	−3.6	63	30	1,975	5.3	47	30	1,950	−.8	54	30	2,013	10.5	57	30	2,059	11.9	60	30	2,013	8.7	37	30	1,929	−2.3	47
750	30	2,410	−6.3	60	30	2,504	1.9	48	30	2,472	−2.7	46	30	2,555	7.4	53	30	2,601	10.6	----	30	2,551	5.5	35	30	2,445	−5.0	47
700	30	2,941	−8.7	56	30	3,052	−1.8	53	30	3,008	−5.2	42	30	3,114	4.4	42	30	3,169	8.2	----	30	3,104	2.2	34	30	2,978	−7.6	51
650	30	3,519	−11.6	50	30	3,643	−5.4	48	30	3,591	−8.3	38	29	3,713	.7	38	30	3,780	5.3	----	30	3,700	−1.4	29	30	3,559	−10.8	49
600	30	4,121	−14.9	45	30	4,261	−9.5	46	30	4,204	−11.9	38	29	4,350	−3.8	34	30	4,427	1.7	----	30	4,321	−5.5	30	30	4,163	−14.4	50
550	30	4,777	−19.1	42	30	4,933	−14.0	45	30	4,862	−16.1	38	29	5,030	−8.6	34	30	5,122	−2.8	----	30	5,009	−10.2	29	30	4,823	−18.7	51
500	29	5,472	−24.2	----	30	5,645	−19.1	43	30	5,576	−21.2	----	29	5,763	−13.9	34	28	5,868	−7.7	----	30	5,734	−15.5	31	30	5,521	−23.6	----
450	27	6,227	−29.7	----	30	6,428	−24.9	----	30	6,346	−27.0	----	29	6,562	−19.6	33	27	6,684	−13.5	----	30	6,527	−21.6	----	29	6,292	−29.2	----
400	27	7,062	−35.5	----	30	7,265	−31.4	----	30	7,182	−33.2	----	29	7,419	−26.1	----	27	7,562	−20.0	----	30	7,377	−28.2	----	28	7,123	−35.3	----
350	27	7,979	−41.7	----	30	8,196	−38.8	----	30	8,107	−40.3	----	28	8,373	−33.1	----	27	8,539	−27.0	----	30	8,320	−35.5	----	28	8,040	−42.3	----
300	27	9,009	−47.7	----	29	9,232	−47.3	----	30	9,141	−47.9	----	27	9,445	−40.7	----	27	9,631	−35.2	----	29	9,384	−43.5	----	24	9,050	−49.9	----
250	24	10,199	−51.5	----	28	10,421	−54.8	----	29	10,323	−54.2	----	26	10,674	−49.2	----	26	10,877	−44.5	----	29	10,586	−52.2	----	18	10,228	−54.2	----
200	21	11,645	−52.0	----	23	11,837	−58.3	----	29	11,745	−55.4	----	22	12,120	−56.8	----	25	12,332	−55.7	----	28	12,003	−59.1	----	11	11,662	−55.3	----
175	17	12,507	−52.4	----	17	12,688	−54.7	----	27	12,603	−53.8	----	20	12,959	−59.6	----	22	13,169	−61.9	----	27	12,839	−59.5	----	----	----	----	----
150	14	13,494	−53.1	----	13	13,668	−54.1	----	26	13,591	−53.0	----	15	13,938	−60.8	----	20	14,106	−67.8	----	25	13,800	−58.8	----	----	----	----	----
125	10	14,601	−55.0	----	9	14,852	−56.1	----	23	14,755	−53.9	----	11	15,076	−62.4	----	15	15,201	−72.4	----	24	14,938	−59.4	----	----	----	----	----
100	----	----	----	----	----	----	----	----	18	16,182	−54.5	----	5	16,456	−66.6	----	8	16,508	−77.4	----	23	16,327	−61.0	----	----	----	----	----
80	----	----	----	----	----	----	----	----	13	17,613	−55.2	----	----	----	----	----	----	----	----	----	19	17,700	−62.2	----	----	----	----	----
60	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5	19,443	−62.0	----	----	----	----	----

Standard pressure surface (mb.)	Spokane, Wash. (931.9 mb.)				Swan Island, W. I.[1] (----- mb.)				Tacubaya, Mex. (772.6 mb.)				Tampa, Fla. (1,015.9 mb.)				Tatoosh Island, Wash. (1,015.7 mb.)				Toledo, Ohio (992.3 mb.)				Washington, D. C. (1,011.9 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	29	721	11.1	50	----	----	----	----	30	2,306	19.7	30	30	9	20.4	78	30	31	8.1	86	30	191	6.3	74	30	25	11.8	63
1,000	29	125	(*)	----	----	----	----	----	30	14	(*)	----	30	146	20.5	73	30	159	7.3	84	30	126	(*)	----	30	124	11.6	63
950	29	560	(*)	----	----	----	----	----	30	484	(*)	----	30	590	18.7	66	30	584	5.0	80	30	552	7.3	58	30	553	9.4	57
900	29	1,012	10.9	42	----	----	----	----	30	966	(*)	----	30	1,051	16.2	59	30	1,020	2.9	73	30	994	4.8	56	30	997	7.0	59
850	29	1,486	7.0	44	----	----	----	----	30	1,469	(*)	----	30	1,536	13.9	55	30	1,481	1.1	65	30	1,457	2.2	54	30	1,465	4.1	60
800	29	1,980	3.2	48	----	----	----	----	30	2,002	(*)	----	30	2,045	11.4	48	30	1,966	−1.2	61	30	1,945	−.2	50	30	1,956	1.5	58
750	29	2,502	−.6	47	----	----	----	----	30	2,560	17.9	20	30	2,585	8.5	41	30	2,485	−3.8	60	30	2,467	−2.5	46	30	2,478	−.9	54
700	29	3,047	−4.1	46	----	----	----	----	30	3,146	13.3	32	30	3,148	5.5	36	30	3,020	−6.8	57	30	3,004	−5.1	42	30	3,021	−3.8	51
650	29	3,631	−8.2	48	----	----	----	----	30	3,765	8.0	38	30	3,751	2.1	32	30	3,600	−9.7	51	30	3,591	−8.5	42	30	3,604	−7.2	47
600	29	4,244	−12.1	44	----	----	----	----	30	4,419	2.6	44	30	4,390	−2.2	34	30	4,209	−13.5	50	30	4,199	−12.2	41	30	4,220	−11.0	44
550	29	4,906	−16.5	42	----	----	----	----	30	5,120	−2.8	51	30	5,071	−7.0	37	30	4,867	−17.9	51	30	4,864	−16.9	39	30	4,884	−15.3	38
500	29	5,614	−21.3	----	----	----	----	----	30	5,865	−7.9	42	30	5,813	−11.6	38	30	5,573	−22.0	----	30	5,567	−22.0	----	30	5,598	−20.0	35
450	29	6,389	−26.5	----	----	----	----	----	30	6,690	−13.3	----	30	6,614	−17.1	37	30	6,345	−27.0	----	30	6,341	−27.6	----	30	6,375	−25.5	----
400	29	7,223	−32.6	----	----	----	----	----	30	7,563	−19.3	----	30	7,486	−23.3	----	30	7,180	−32.8	----	30	7,170	−34.1	----	30	7,214	−31.6	----
350	29	8,150	−39.5	----	----	----	----	----	29	8,540	−27.4	----	30	8,447	−30.7	----	30	8,107	−39.5	----	30	8,090	−40.8	----	30	8,145	−38.0	----
300	28	9,191	−47.2	----	----	----	----	----	29	9,630	−36.1	----	30	9,523	−38.8	----	30	9,144	−47.0	----	30	9,124	−47.2	----	30	9,191	−44.9	----
250	28	10,375	−54.7	----	----	----	----	----	28	10,871	−45.7	----	30	10,746	−48.8	----	30	10,332	−53.7	----	27	10,311	−52.3	----	30	10,391	−50.7	----
200	22	11,800	−59.0	----	----	----	----	----	24	12,324	−56.6	----	28	12,182	−58.4	----	30	11,751	−56.9	----	25	11,736	−53.9	----	29	11,830	−55.3	----
175	21	12,638	−56.6	----	----	----	----	----	22	13,160	−61.9	----	28	13,014	−61.5	----	29	12,598	−54.9	----	25	12,593	−53.6	----	28	12,681	−55.0	----
150	12	13,613	−56.3	----	----	----	----	----	18	14,105	−66.4	----	26	13,969	−63.7	----	26	13,587	−53.2	----	24	13,575	−53.9	----	25	13,656	−54.8	----
125	11	14,767	−55.8	----	----	----	----	----	16	15,194	−70.9	----	26	15,079	−66.5	----	28	14,761	−53.6	----	20	14,740	−55.4	----	21	14,815	−57.0	----
100	8	16,170	−56.5	----	----	----	----	----	10	16,511	−74.6	----	26	16,416	−69.7	----	22	16,194	−54.5	----	17	16,149	−56.8	----	17	16,215	−58.6	----
80	6	17,589	−56.0	----	----	----	----	----	5	17,822	−75.6	----	12	17,753	−70.4	----	16	17,620	−54.2	----	10	17,563	−57.7	----	11	17,603	−59.9	----
60	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7	19,443	−54.1	----	5	19,395	−57.5	----	----	----	----	----

[1] Data not yet received.

*Temperature and relative humidity data for this level are not available or are available only for certain days. See note entitled "Change in Summarization of Radiosonde Data," p. 6, in the January 1946 issue of the MONTHLY WEATHER REVIEW.

NOTE.—All observations scheduled between 0300 and 0500, G. C. T. except at Ciudad, Victoria, Mazatlan and Merida, where they are taken near 0200, G. C. T. "Number of observations" refers to those of dynamic height only. (In a few cases temperature or humidity data may be missing for one or more standard pressure surfaces of some observations.) Relative humidity data are not published for standard pressure surfaces having a corresponding mean temperature below −20° C. Relative humidity data beginning with October 1, 1948, were computed, and expressed in these tables, on the basis of vapor pressure over water. Upper air values of relative humidity at levels with temperatures less than 0° C. have formerly been computed and expressed on the basis of the vapor pressure over ice. All relative humidity observations are obtained by electric hygrometer and have been adjusted to compensate for the values occurring below the operating range of the humidity element. For explanation of the adjustment see article entitled "Curve Method for Obtaining Monthly Means of Relative Humidity," p. 241, MONTHLY WEATHER REVIEW, December 1944.

None of the means included in these tables are based on less than 15 observations at the surface or 5 observations at a standard pressure level.

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 2200 G. C. T. during April 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Abilene Tex. (534 m.)			Albuquerque, N. Mex. (1,627 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (505 m.)			Boise, Idaho (858 m.)			Brownsville, Tex. (7 m.)			Buffalo, N. Y. (220 m.)			Burlington, Vt. (100 m.)			Charleston, S. C. (16 m.)			Cincinnati, Ohio (273 m.)			Denver, Colo. (1,618 m.)			El Paso, Tex. (1,198 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	29	355	0.4	30	289	1.7	24	283	3.2	30	295	2.8	30	263	2.0	30	307	2.8	30	121	4.0	29	263	4.3	30	309	1.4	30	218	3.0	29	309	1.5	29	329	1.5	30	250	2.5
500							24	269	3.8				29	265	4.8				30	126	4.6	29	270	4.8	30	289	2.6	30	213	5.3	29	290	1.5						
1,000	29	259	.5				20	271	4.7				29	272	4.8	30	293	2.4	24	167	2.8	23	278	4.7	29	275	4.7	25	235	6.7	27	268	2.7						
1,500	26	230	1.7				20	273	5.5	30	301	3.8	27	283	5.1	30	281	2.1	19	205	1.0	21	273	4.8	26	270	6.2	24	265	8.0	25	278	3.3				30	348	2.4
2,000	21	241	2.3	30	271	2.7	20	281	8.4	30	288	4.5	27	295	7.1	30	272	2.6	17	244	3.3	16	283	6.0	23	274	8.2	22	276	9.6	25	280	4.4	29	341	2.4	30	253	3.4
2,500	19	278	3.1	30	268	3.0	19	282	11.8	30	283	5.1	27	300	8.3	29	255	3.7	14	265	3.8	15	284	7.7	15	270	8.6	21	282	12.1	23	284	5.3	29	321	2.6	29	265	2.8
3,000	18	280	4.2	30	269	3.7	19	283	11.7	27	286	7.2	25	294	10.2	28	256	5.0	12	268	4.8	14	293	8.4	12	295	8.0	21	289	14.9	17	279	7.2	25	297	3.3	27	267	4.9
4,000	18	270	8.6	30	284	5.3	15	293	16.1	25	286	10.2	18	295	10.5	25	272	7.0	11	256	6.6	12	305	8.6				20	284	17.2	14	278	7.4	22	290	5.8	27	268	7.2
5,000	15	270	13.5	25	292	6.3	13	285	18.4	19	289	10.0	15	305	10.7	21	289	7.1	10	273	9.1	11	308	12.2				15	285	18.1	11	292	10.0	22	295	7.0	25	284	9.7
6,000	12	284	16.0	23	301	7.7	11	260	20.0	16	290	10.0				18	297	8.9										11	264	22.0	10	297	16.3	15	290	8.6	21	275	14.0
8,000	11	283	20.7	17	310	10.7										13	315	8.9																		13	271	16.4
10,000				13	302	11.2																																

Altitude (meters) m. s. l.	Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,475 m.)			Greensboro, N. C. (271 m.)			Havre, Mont. (767 m.)			Jacksonville, Fla. (16 m.)			Joliet, Ill. (178 m.)			Las Vegas, Nev. (663 m.)			Little Rock, Ark. (88 m.)			Medford, Oreg. (416 m.)			Miami, Fla. (12 m.)			Mobile, Ala. (66 m.)			Nashville, Tenn. (182 m.)			New York, N. Y. (15 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	30	304	2.6	30	311	2.1	25	255	3.4	30	277	4.7	28	117	0.8	30	344	1.1	30	213	0.6	30	11	0.5	30	331	2.1	30	157	3.5	26	224	1.8	27	278	1.4	29	262	2.9
500							25	261	5.1				28	225	1.2	30	337	1.3				30	311	1.1	30	326	2.0	30	159	4.4	26	222	2.2	27	308	1.6	29	252	5.1
1,000							25	266	6.5	30	272	7.0	26	222	4.5	28	286	1.2	30	199	.7	27	263	1.8	30	292	1.7	30	189	3.4	23	268	3.3	25	296	1.7	28	271	6.6
1,500				30	310	2.3	25	270	7.8	30	261	8.1	24	227	6.5	26	256	1.8	30	198	1.0	24	277	3.6	29	240	2.6	29	221	3.5	19	278	4.0	22	247	4.2	25	291	7.5
2,000	30	307	2.6	30	301	3.1	25	267	7.1	29	258	7.9	24	244	8.3	25	269	2.5	30	243	1.2	21	282	6.3	28	232	3.0	26	235	4.8	18	282	5.3	22	266	7.2	23	300	8.4
2,500	30	303	2.1	30	288	2.8	24	278	10.9	29	266	7.5	23	252	9.3	20	280	3.8	30	258	1.9	19	293	9.0	26	230	3.2	23	234	5.4	17	277	6.9	19	275	9.3	20	300	10.5
3,000	30	283	1.5	30	272	3.2	22	292	14.7	23	271	8.7	22	255	11.3	17	295	5.3	30	259	2.4	15	293	11.1	24	228	3.7	20	237	5.8	16	271	8.9	19	280	11.6	17	301	12.3
4,000	28	254	2.6	28	288	4.0	15	291	16.3	18	273	9.2	16	276	12.4	12	323	4.9	29	271	1.8	13	285	12.4	22	250	5.5	15	235	8.5	15	273	12.3	17	285	16.1	14	296	12.9
5,000	25	271	4.4	24	307	7.1	14	288	19.5	16	293	11.8	15	268	14.0	11	318	6.7	27	304	3.1	12	284	15.5	20	264	3.6	11	246	9.2	12	255	17.4	14	282	18.2			
6,000	23	289	7.5	22	299	9.0				10	294	11.2	13	269	16.6	10	327	8.0	25	314	6.1				17	274	5.4				10	253	19.7						
8,000	14	296	12.9	16	302	11.3													19	312	11.0				16	252	9.8												
10,000																			14	295	15.4																		

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)			Oklahoma City, Okla. (396 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (338 m.)			Rapid City, S. Dak. (982 m.)			St. Cloud, Minn. (318 m.)			St. Louis, Mo. (181 m.)			San Antonio, Tex. (240 m.)			San Diego, Calif. (13 m.)			Sault Ste. Marie, Mich. (221 m.)			Seattle, Wash. (116 m.)			Spokane, Wash. (725 m.)			Washington, D. C. (24 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	30	262	5.6	26	135	1.0	29	239	0.5	30	249	1.2	29	333	1.8	30	267	2.0	29	3	0.6	26	60	1.0	30	269	3.5	30	295	4.5	30	236	3.1	30	230	3.2	30	261	3.1
500	30	287	4.0	26	131	.8	29	260	.5	30	247	1.9				30	265	2.5	29	290	.9	26	51	.5	29	275	2.6	30	286	4.8	30	227	4.1				30	261	5.0
1,000	28	295	2.6	26	152	.6	29	193	.3	30	260	2.1	29	333	1.8	30	267	3.2	28	222	.9	25	304	.1	27	285	2.1	29	292	3.8	27	219	5.8	30	227	4.4	29	272	5.5
1,500	28	260	2.1	23	240	1.0	27	236	2.2	29	251	2.0	29	312	2.5	29	265	4.6	24	250	1.4	22	275	2.1	23	288	1.4	28	296	3.9	23	211	8.0	30	228	4.6	29	271	6.0
2,000	27	274	2.5	21	244	2.8	26	268	2.3	29	252	1.7	28	279	2.7	26	270	5.2	21	296	3.9	18	261	4.3	23	290	.6	28	293	5.5	21	218	8.9	29	234	5.4	27	271	7.6
2,500	27	275	3.0	19	250	4.8	26	299	3.5	28	247	.8	28	280	4.6	26	272	5.9	20	304	6.2	14	273	5.7	23	355	1.5	24	301	7.7	18	222	9.6	26	251	6.5	24	271	8.2
3,000	27	267	3.7	18	271	6.3	25	299	5.8	28	238	1.0	27	285	6.3	24	288	7.4	18	299	8.4	13	269	7.8	23	348	1.9	21	307	7.4	14	235	10.8	22	254	8.2	24	280	9.8
4,000	27	277	3.9	16	283	7.6	24	305	7.6	28	285	3.5	24	296	9.6	19	303	9.3	18	299	9.8	11	279	11.9	22	318	5.2	21	315	8.6	10	237	12.7	19	268	10.0	20	288	13.8
5,000	26	293	5.3	15	293	9.0	17	312	9.7	26	296	5.7	21	295	8.6	19	304	10.6	12	297	9.9	11	278	15.8	18	301	7.4	18	312	11.5				16	273	12.1	16	295	15.7
6,000	25	284	6.0	13	299	9.7	16	311	10.3	24	289	8.7	19	311	10.2	16	311	12.7				10	277	17.9	16	296	8.9	16	316	13.5				16	270	13.1	12	296	17.7
8,000	18	279	8.3				13	301	15.9	16	300	11.1	10	295	14.8	11	317	7.9							11	302	13.4										10	288	22.4
10,000	12	287	9.3																																				

TABLE 3.—*Free-air resultant winds based on rawin observations made near 0300 G. C. T. during April 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,636 m.)			Big Spring, Tex. (774 m.)			Bismarck, N. Dak. (505 m.)			Brownsville, Tex. (7 m.)			Caribou, Maine (191 m.)			Charleston, S. C. (13 m.)			Columbia, Mo. (237 m.)			Grand Junction, Colo. (1,473 m.)			Greensboro, N. C. (275 m.)			Hatteras, N. C. (3 m.)			International Falls, Minn. (358 m.)			Little Rock, Ark. (80 m.)			Medford, Oreg. (401 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	30	202	1.5	30	96	2.3	30	69	0.9	30	102	3.2	30	322	1.4	30	218	1.1	30	357	1.3	30	339	0.6	30	278	1.5	30	233	1.5	30	208	0.6	30	280	0.4	30	317	2.7
500										30	114	5.0	30	296	2.7	30	250	5.1	30	17	.8				30	267	3.4	30	259	5.6	30	230	1.3	30	275	1.1	30	317	3.4
1,000				30	97	3.5	28	276	1.7	30	117	3.6	30	289	3.3	30	253	6.2	28	348	.7				30	273	6.2	30	269	7.2	30	267	3.9	30	267	2.9	30	308	3.7
1,500				30	110	1.9	28	289	4.3	30	139	1.9	30	285	3.5	30	264	7.7	28	295	2.1	28	335	.8	30	271	6.7	30	274	9.0	30	280	5.4	30	277	4.3	30	286	2.2
2,000	30	213	.9	30	238	1.6	28	297	6.4	30	241	1.8	30	282	4.5	30	268	9.5	28	296	3.8	28	326	1.6	30	269	8.0	28	269	7.4	30	293	6.5	30	265	5.9	30	257	1.4
2,500	30	258	2.0	30	262	3.8	28	300	7.8	30	251	3.8	29	287	5.4	30	270	10.8	28	302	5.4	28	315	2.0	30	272	9.2	28	275	10.1	30	296	7.0	30	267	6.4	30	243	2.8
3,000	29	286	4.3	30	272	5.2	29	302	8.6	30	243	5.5	29	283	7.3	30	269	12.0	28	302	7.7	29	313	2.7	30	269	10.8	27	272	11.5	30	304	7.7	30	268	7.8	30	245	3.8
4,000	29	288	5.3	30	278	8.5	30	305	9.7	30	246	8.7	29	286	9.0	28	273	12.8	28	298	9.5	29	322	3.5	30	271	12.6	24	267	16.3	30	305	9.6	29	268	10.0	30	271	6.9
5,000	28	305	5.9	30	277	10.5	30	304	11.1	30	254	12.6	29	273	10.1	26	252	16.1	26	294	10.7	29	314	4.4	30	272	17.7	23	288	18.9	30	300	11.5	27	270	12.4	30	265	8.0
6,000	28	315	7.5	30	279	11.1	28	300	12.3	30	258	16.7	28	281	12.5	24	257	17.2	25	298	11.8	30	325	7.4	27	280	20.2	21	274	20.1	29	296	13.6	22	254	12.4	29	267	8.8
8,000	26	296	10.4	28	264	16.7	23	283	12.2	28	261	20.3	27	280	15.3	19	254	22.7	22	289	15.6	27	296	7.0	25	285	27.1	17	257	27.2	25	300	15.0	21	238	18.7	22	261	11.8
10,000	23	277	17.3	24	275	21.0	20	276	11.9	23	262	24.7	20	263	23.0	16	271	26.2	15	262	19.7	22	290	10.1	20	269	21.5	12	287	31.6	20	307	14.6	19	238	25.7	19	259	10.7
12,000	17	284	19.7	18	261	26.3	12	304	11.5	11	268	18.4	10	260	18.3				10	268	23.6	14	291	12.0	11	259	36.2				10	316	17.0	13	252	30.0	13	263	8.9
14,000				12	254	20.2																10	65	13.3														

Altitude (meters) m. s. l.	Miami, Fla. (12 m.)			Nantucket, Mass. (14 m.)			Nashville, Tenn. (180 m.)			New Orleans, La. (6 m.)			Oakland, Calif. (8 m.)			Oklahoma City, Okla. (392 m.)			Rapid City, S. Dak. (980 m.)			San Antonio, Tex. (242 m.)			San Juan, P. R. (28 m.)			St. Cloud, Minn. (318 m.)			Santa Maria, Calif. (72 m.)			Sault Ste. Marie, Mich. (221 m.)			Spokane, Wash. (726 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	30	133	0.6	29	254	0.9	30	298	0.9	30	69	0.6	30	274	4.5	29	180	0.3	30	157	1.3	30	47	2.1	30	103	3.3	30	180	0.1	30	270	2.6	30	312	1.9	30	221	2.3
500	30	159	2.2	29	256	4.2	30	285	.4	30	207	.4	30	291	4.2	29	202	.6				30	80	3.2	30	93	6.3	29	239	.7	29	333	3.6	30	308	2.1			
1,000	30	205	1.7	29	284	4.4	30	238	4.1	30	263	1.5	30	295	3.7	29	215	.7	30	158	1.3	30	115	2.5	29	94	6.4	29	296	2.4	29	337	4.7	30	311	2.1	30	234	4.4
1,500	30	219	3.2	29	286	5.6	30	232	6.1	30	262	1.8	30	300	2.5	30	309	.9	30	213	2.1	30	173	1.9	28	92	5.6	29	303	3.5	29	357	4.0	30	308	3.2	30	242	6.1
2,000	30	227	3.8	28	283	8.8	30	262	7.0	30	255	3.3	30	313	2.5	30	289	3.2	30	267	3.5	30	242	2.9	28	90	4.7	29	304	4.6	29	6	4.2	30	308	4.8	30	247	7.0
2,500	30	236	4.1	28	281	9.2	30	269	9.5	29	253	6.0	30	317	2.2	30	279	4.3	30	284	5.0	30	261	4.8	28	89	4.2	29	300	5.7	29	355	4.5	30	312	5.3	30	249	7.5
3,000	30	232	4.3	27	280	11.3	30	273	12.0	29	265	7.7	30	293	2.2	30	284	6.2	28	294	6.7	30	269	6.2	28	85	4.0	29	310	7.4	30	342	3.5	29	312	6.5	30	260	8.4
4,000	29	244	8.5	25	275	15.1	29	278	13.6	28	259	11.3	30	293	2.7	30	288	7.6	28	307	8.7	29	269	10.0	29	82	3.1	29	307	9.3	30	310	4.2	28	311	8.0	30	259	10.1
5,000	29	257	11.1	25	271	18.6	27	277	15.0	27	260	15.2	30	302	4.4	30	281	8.6	27	310	9.0	28	263	13.1	29	63	1.5	28	301	9.9	30	304	5.2	28	306	8.4	28	259	12.0
6,000	29	256	14.2	22	273	20.0	26	277	17.7	27	259	19.8	30	295	7.0	30	280	10.1	23	307	8.2	28	264	15.7	27	249	.3	28	296	10.1	30	299	7.6	27	301	10.5	26	262	12.4
8,000	28	263	20.1	13	272	20.2	21	256	23.5	22	252	24.7	28	282	9.8	28	271	12.8	17	266	5.4	26	262	21.0	26	297	6.5	25	288	10.6	29	293	11.2	24	292	12.6	21	277	13.0
10,000	26	284	24.0				16	248	31.1	16	256	26.4	23	262	11.9	25	256	17.4	15	275	11.7	21	270	25.4	26	296	15.8	22	302	13.2	25	264	16.3	13	314	10.3	18	278	15.5
12,000	22	287	28.8										16	264	14.3	18	256	21.6				12	265	27.2	25	295	22.3	21	301	12.5	22	270	19.5				12	275	13.1
14,000	12	264	31.2										10	262	11.0	14	254	16.7							18	291	20.9	13	282	10.4	17	267	16.6						
16,000																														15	256	11.1						
18,000																														10	265	6.4						

Altitude (meters) m. s. l.	Tatoosh Island, Wash. (33 m.)		
	Observations	Direction	Speed
Surface	30	209	2.2
500	30	208	4.1
1,000	29	219	5.0
1,500	29	226	6.8
2,000	29	236	8.1
2,500	29	238	9.3
3,000	29	242	10.1

Altitude (meters) m. s. l.	Tatoosh Island, Wash. (33 m.)		
	Observations	Direction	Speed
4,000	28	245	13.4
5,000	28	249	17.3
6,000	26	263	18.5
8,000	21	267	26.0
10,000	15	261	20.8
12,000	12	262	23.3

NOTE.—Resultants prepared from rawins at high altitudes are biased toward lower wind speeds. Values appearing in this table should therefore be used with caution when the number of observations missing is greater than three. See note following Table III in the June 1948 issue of the MONTHLY WEATHER REVIEW.

RIVER STAGES AND FLOODS FOR APRIL 1949

The most damaging floods during the month occurred in the lower Rio Grande in Texas, seriously affecting growing crops. Considerable damage also resulted from the flash flood at Herington, Kans., and from the flooding on the Souris and Heart Rivers in North Dakota in connection with the ice break-up there. The crest on the lower Missouri at Nebraska City, Nebr., was second only to the great ice jam flood of March 1949, but was the highest of record for stages uninfluenced by ice conditions.

Precipitation during April was mostly below normal (see chart V). It was above normal over most of the southern states, portions of the Missouri Basin, and the central portion of the northeastern states. The heaviest precipitation occurred in northern Florida and southern Texas where it averaged 200 percent of normal.

Hudson Bay drainage.—Snowfall was heavy during the winter in the Red River Valley of the North from Fargo-Moorhead, northward to the Canadian border. The snow-cover ranged from 12 to 26 inches in this section with local depths of 61 inches at Grafton and 33 inches at Hannah, N. Dak. by the end of February. South of Fargo, the snow-cover was much lighter ranging up to 11 inches. During the second week of March, the water equivalent of the snow-cover ranged from 3 to 5 inches in the northern portion, with the heavier amounts in the Devil's Lake and Souris basins, and from 1 to 2 inches in

the southern portion. The average precipitation from November through March was 3.81 inches, which was considerably lighter than one year ago when it averaged 4.85 inches.

The Forest and Park Rivers began to overflow on April 8 in the vicinity of Minto and Grafton, N. Dak., respectively. On the 9th, the Red River of the North began overflowing at Grand Forks, N. Dak., cresting on the following day at a stage of 29.2 feet, 1.2 feet above bankfull stage, but considerably below last year's crest of 41.6 feet. No other flooding occurred along the main stem. The highest stage reached at the Fargo-Moorhead gage was 12.8 feet, 4.2 feet below bankfull stage or 5.2 feet below last year's crest of 18 feet. Some damage resulted to highways and farm equipment in the vicinity of Minto and Grafton, N. Dak.

Atlantic Slope Drainage.—Stream flow was considerably below normal in the Connecticut and Merrimack River Basins during April even though precipitation was near normal as there was very little runoff from melting snow. The light seasonal snowfall was depleted early and by April 1, 95 percent of the snow cover had already melted (see chart VII). The highest stage reached by the Connecticut at Hartford, Conn., this spring was 14.5 feet, 1.5 feet below bankfull stage, in March. In the past 100 years, only 5 maximum spring stages have been equal to or less than this low value at that point.

Moderate to heavy rises in the streams in the Middle Atlantic States resulted from the heavy rains on the 13th and 14th with major flooding on the Jackson and upper James Rivers and minor flooding in the upper Rappahannock and Roanoke Rivers.

The rain in the upper Rappahannock in Virginia averaged 1.5 inches and caused light local flooding for a few hours at Remington, Va., on the 14th. The rains were much lighter in the lower Rappahannock and on the Rapidan and resulted in stages near one-half bank full.

In the Jackson River Basin, the rainfall averaged 3.1 inches and in the James River above Lynchburg, Va., 2.3 inches in the 24-hour period ending in the afternoon of the 13th. This storm produced the highest water at and above Buchanan, Va., since the great flood of 1936. The principal damage resulting from the flood was to the road bed of the C&O railroad at Kincaid Gorge between Covington and Hot Springs where two washouts occurred, and near Lowmoor on the main line where a fill gave way necessitating the use of east bound tracks only. Two slides on Route 60 between Covington and Clifton Forge blocked the highway for a while but were cleared for one-way traffic early on the 14th. In Covington, 13 homes were evacuated as a precautionary measure and schools closed. Below Buchanan the only damage of consequence was the washing out of a small bridge on a secondary highway at Buffalo station in Nelson County. Only minor flooding occurred below Bremo Bluff.

The Roanoke River rose rapidly to above flood stage at Alta Vista, Va., due to the heavy rain (2 inches) in the Bedford area. The crest flattened considerably as it moved downstream; as a result, the river just reached flood stage at Weldon, N. C., and with the exception of Williamston, did not reach flood stage at any other station.

East Gulf of Mexico drainage.—Heavy rain from the 28th through the 30th caused flooding in several streams in the East Gulf of Mexico drainage during the latter part of April and the beginning of May. Rainfall ranged from 1 inch to as much as 6 inches in the upper Flint and middle Chattahoochee Rivers.

A rapid rise on the Tallapoosa River at Milstead, Ala., amounted to 31.8 feet in the 24-hour period ending at 7:30 a. m., on the 30th. The river crested at a stage of 41.5 feet, 1.5 feet above flood stage during the afternoon of that date.

Upper Mississippi Basin.—The light flood in the Minnesota River at Mankato, Minn., was due to moderately heavy rain and snow that fell during the closing days of March when the river was at a high stage as a result of the spring ice break-up.

By the end of April, base ground flow in the tributary streams in Wisconsin was unusual for this month. Usually the stream flow is the greatest for the year during April but due to gradual snow-melt and precipitation far below normal, there was barely enough run-off to satisfy the storage requirements of the headwater reservoirs. Nearly normal flat pools were attained in the Mississippi River between St. Paul and Lock and Dam No. 10 by the 30th. Light flooding occurred at Hannibal and Louisiana, Mo.

Missouri Basin.—The streams in the central and western portions of the Elkhorn Basin in Nebraska were generally rising at the beginning of the month due to the rapid melting of the heavy snow that fell during the period from March 26 through March 31. The heavy snow in the western and northern sections of the Elkhorn Basin accumulated to depths of 8 to 15 inches in the Neligh-Atkinson area and from 5 to 8 inches in the Royal-Randolph area. Rapid thawing from March 27–29 produced overflows from Ewing westward to Atkinson, Nebr., on March 28. On March 30, heavy rain (in excess of 1 inch) occurred in the northern and central sections of the valley. On March 31, overflows were occurring from the headwaters of the Elkhorn to Meadow Grove, and near West Point, Nebr., light flooding occurred at some points through April 12

Much flooding occurred on the Souris River and its tributaries in north-central North Dakota between the 3d and 20th due to the melting of the heavy snow cover in that region. U. S. Highway No. 2 was closed from April 4th to the 9th and many other roads were closed for longer periods while under water. Several basements were flooded at Velva and Minot, N. Dak.

The local flooding on the Cannonball, Little Missouri, Heart and Knife Rivers in North Dakota during the latter part of March was due to the ice break-up and run-off from the melting of the heavy snow cover. The snow-melt caused the small streams to run near bank full but no flooding would have occurred if the rivers had been clear of ice.

Serious flooding developed on the Heart River in the Mandan, N. Dak., area due to severe ice jams during the latter part of March, and early April. It was running bank full and was full of ice on March 28 from south of Richardton to south of New Salem, N. Dak. It began to overflow the lowlands near Mandan in the early afternoon of that date and on the following day as the dike on the southeast side of "Dogtown" broke, flooded state highway No. 6, and U. S. Highway No. 10 between Bismarck and Mandan. On March 30th, there was water in about 100 houses, south of the Northern Pacific Railway tracks in Mandan. The ice jams were dynamited several times but new jams formed after the old ones were blown out. The ice jam at the "Dogtown" bridge broke on April 1st; by the 3d most of the water had receded from the Mandan area and on the 6th, U. S. Highway No. 10 was reopened.

The Big Sioux River rose above flood stage at Akron, Iowa, on March 29, and remained above flood until April 2. A secondary rise caused it to overflow again at Akron from the 6th to the 11th. The secondary crest was 5 feet above flood stage but due to the early season of the year no damage occurred.

The high water on the Missouri River during April was

due largely to melting snow and the spring ice break-up along the main stem and tributaries above Pierre, S. Dak. The low temperatures during the winter favored unusually heavy ice to form on the majority of streams. These low winter temperatures and heavy precipitation are illustrated by the charts which appeared in the reports of River Stages and Floods in the February and March issues of the REVIEW, and are discussed in detail in the article by William H. Klein which appears in this issue.

The ice had broken on the Missouri as far north as Pierre, S. Dak., by March 24, but did not break, at Mobridge until April 1. Two crests came down the Missouri; the first occurred at Bismarck on April 3, reaching Sioux City, Iowa on the 8th; the second occurred at Bismarck on the 6th, reaching Sioux City on the 10th. The river was high in the Garrison-Bismarck area from the 1st to the 4th but no flooding occurred. Bank full stages were exceeded at several points in the Missouri below Mobridge, S. Dak. The floods were not as serious as in February and March. The most outstanding feature of the floods this month was the high stage at Nebraska City, Nebr., where the crest of 20.3 on the 13th and 14th was second only to the great ice jam flood of the previous month, when a stage of 25.8 feet was reached. However, the April crest was the highest of record unifluenced by ice conditions; the previous high mark of 20.2 occurred in 1947. The damages along the main stem were mostly light but would have been much larger had it not been preceded by severe flooding during the 1st quarter of 1949.

The worst flood in two decades and the most destructive in the history of Herington, Kans., occurred in the west and north sections of that city on the evening of April 30. The flash-flood waters moved down Lime Creek, which flows in a northerly course across the low areas of Herington. The water reached a depth of over 5 feet in the City Building. Much of the damage was concentrated in a three-block business section outside of the main part of the city. The flood waters were believed to be about four inches under the 1929 flood level, which claimed a number of lives. No lives were lost in this flood, but several injuries were reported. However, the intensity of this flood was thought to be much greater and the financial loss much larger.

This flood was due to intense heavy rain over the small drainage basin. Rainfall 2½ miles west southwest of the city at Lake Herington, totaled 1.8 inches but was apparently much heavier along Lime Creek.

Forty families were rendered homeless pending repairs to their homes. Three houses were floated from their foundations, several porches were washed away and several cars floated through the inundated streets.

Ohio Basin.—Stages continued above flood in the lower portion of the Ohio and lower tributaries during the first few days of the month due to the heavy rain on March 26 and 27. The only additional flooding that resulted from this storm was on the Tennessee River at Gilbertsville, Ky., and Whitesburg, Ala.

White, Arkansas and Red Basins.—Flooding occurred in the White Basin in the White and Black Rivers during March and April. The lower White fell below bankfull stage at Clarendon and St. Charles, Ark., during the latter part of April for the first time since mid-January. All crests during March and April were secondary and were only slightly above flood stage except the Black. Planting was delayed on lowlands adjacent to these streams; otherwise, loss was negligible.

The only flooding in the Arkansas Basin during April was a minor overflow on the Neosho River in the vicinity of Emporia, Kans., on the 11th and was due to rainfall averaging 1.5 inches above that point. Unofficial reports were received of amounts over 3 inches between Council Grove and Emporia, Kans.

The winter season snowfall averaged 57.9 inches in the Upper Arkansas and Purgatoire River Basins or 103 percent of normal. The water equivalent of this snow was 3.15 inches or 111 percent of normal but soil moisture in this area was largely deficient.

In the Red Basin, minor flooding occurred on the Black, Ouachita, and Sulphur Rivers. The flooding on the Sulphur at Hagansport, Tex., was due to scattered moderate to heavy showers on the 10th and 11th, 26th and 27th.

Lower Mississippi Basin.—Rainfall averaged near or slightly below normal over the Yazoo-Tallahatchie River Basins during April. With the exception of an unimportant rise on the Tallahatchie at Swan Lake, Miss., about the middle of the month, the river levels were generally receding. Local flooding occurred on the Coldwater at Sarah, Miss., due to the heavy rains from the 11th–13th.

The only flooding on the main stem of the Lower Mississippi during April was at Caruthersville, Mo., and Baton Rouge, La. The flooding at Caruthersville was due to the heavy rain over the middle Msssissippi and lower Ohio on March 26 and 27.

West Gulf of Mexico drainage.—The Calcasieu remained very close to or above flood stage throughout the month with a crest of 16.8 at Kinder, La., on the 13th, and 19.8 on the 25th, due to scattered heavy rains on the 5th, 10–11th, 21st–23d, and the 28th. This flood was minor and the main loss was due to the delay in planting crops.

The light flooding on the Bayou Nezpique at Basile, La., was the result of heavy rains from the 21st to the 23d which totaled 6 to 8 inches at some stations.

The slight overflow of the Neches River at Evadale, Tex., from the 2d to the 6th, was due to heavy rains (4 inches) during the last decade of March. The overflow of the Trinity near Liberty, Tex., was due to heavy rains averaging 2.06 inches below Long Lake, on the 20th. No damage occurred.

The Nueces River rose rapidly to above flood stage as a result of the heavy rains from the 19th to the 26th. No serious flooding occurred as the rises downstream were well out of the way before the rise from upstream reached the lower portions of the river.

This same storm caused major flooding on the Guadalupe River from Gonzales, Tex., to the mouth. There were two distinct rises at Gonzales and above but the two bodies of water had merged by the time it reached Cuero and Victoria, Tex. The major rises resulted from the heavy rains over the basin on the 24th and 25th. The heaviest rain, however, was over the Blanco River basin with 7.74 inches at Blanco, Tex., on the 24th. There was considerable damage from the heavy rains and flash floods on the smaller streams of the headwaters of all rivers mostly to bridges and streets, but damage from the floods in the major rivers was only moderate.

The flooding on the lower Rio Grande at and below Rio Grande City was due to heavy rains of 5 to 10 inches between Rio Grande City and Laredo, Tex., during the period from 23d to the 25th. The heavier rains fell on the Mexican side of the Rio Grande. According to the International Boundary Commission, this was the greatest flood ever to occur in April, in respect to volume. Very little rain fell elsewhere in the valley during the flood, so practically all of the flow came from the basin between Rio Grande City and Laredo. Considerable damage resulted to planted crops in the flood plain.

FLOOD STAGE REPORT FOR APRIL 1949

[All dates in April unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
HUDSON BAY DRAINAGE					
	Feet			*Feet*	
Red of North: Grand Forks, N. Dak.	28	9	12	29.2	10
ATLANTIC SLOPE DRAINAGE					
Rappahannock: Remington, Va.	15	14	14	15.5	14
Jackson: Covington, Va.	7	13	14	12.7	14
James:					
Lick Run, Va.		13	14	21.5	14
Buchanan, Va.	17	14	14	20.1	14
Bremo Bluff, Va.	19	14	16	24.0	15
Columbia, Va.	18	14	16	24.0	15
State Farm, Va.	12	15	16	15.2	16
Richmond, Va.	8	15	16	10.5	16
Roanoke:					
Alta Vista, Va.	10	14	15	11.7	15
Weldon, N. C.	31	16	16	31.1	16
Williamston, N. C.	10	Mar. 28	8	11.0	1
		18	29	10.5	20
EAST GULF OF MEXICO DRAINAGE					
				23.6	Dec. 6
				20.6	Jan. 11
Apalachicola: Blountstown, Fla.	15	Dec. 1	26	20.9	Feb. 14
				18.4	Mar. 1
				18.2	18
Tallapoosa: Milstead, Ala.	40	30	30	41.5	30
Black Warrior:					
Tuscaloosa Lock and Dam, Ala.	47	Mar. 31	1	49.5	1
Lock No. 7, Eutaw, Ala.	35	Mar. 28	8	47.5	3
Tombigbee:					
Aberdeen, Miss.	34	Mar. 28	2	39.0	1
Columbus, Miss.	29	Mar. 31	4	29.9	2
Gainesville, Ala.	36	Mar. 30	11	44.9	5
Lock No. 4, Demopolis, Ala.	39	Mar. 28	14	56.2	6
Lock No. 3	33	Mar. 23	17	56.4	7
Lock No. 2	46	Mar. 29	15	57.8	8
Lock No. 1	31	Mar. 25	18	38.7	11
Chickasawhay:					
Enterprise, Miss.	20	Mar. 31	3	26.8	1
Shubuta, Miss.	30	Mar. 30	8	36.5	4
Waynesboro, Miss.	35	3	5	36.4	4
Leaf:					
Hattiesburg, Miss.	22.5	1	4	25.7	3
Beaumont, Miss.	20	1	8	26.6	4
Pascagoula: Merrill, Miss.	22	Mar. 30	10	24.4	6
Bogue Chitto: Franklinton, La.	11	Mar. 31	2	13.7	1
Pearl:					
Edinburg, Miss.	20	Mar. 27	6	22.8	2
Jackson, Miss.	18	Mar. 24	18	30.7	2
Monticello, Miss.	15	Mar. 27	17	25.2	2
Columbia, Miss.	17	Mar. 29	17	24.0	3
				16.7	Nov. 30
				15.0	Jan. 15
				15.8	Jan. 27
Pearl River, La.	12	Nov. 24	30	16.1	Feb. 22
				13.4	Mar. 20
				15.7	Mar. 26
				16.2	8
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Minnesota: Mankato, Minn.	19	1	4	19.9	3
Mississippi:					
Hannibal, Mo.	13	Mar. 31	10	14.3	2
Louisiana, Mo.	12	Mar. 31	11	13.2	3
		13	21	12.2	16, 17, 18
Missouri Basin					
Knife: Hazen, N. Dak.	22	3	3	24.1	3
Big Sioux: Akron, Iowa	12	Mar. 29	2	16.2	Mar. 31
		6	11	17.0	9
Elkhorn:					
Neligh, Nebr.	10	5	8	11.2	7
West Point, Nebr.	12	10	12	12.5	11
Grand:					
Chillicothe, Mo.	18	Mar. 31	1	22.9	Mar. 30
Sumner, Mo.	25	Mar. 31	2	28.9	Mar. 31
Brunswick, Mo.	12	Mar. 28	3	15.1	1
		12	19	13.4	16–18
Chariton: Novinger, Mo.	19	Mar. 30	3	23.0	3
Missouri:					
Pierre, S. Dak.	15	5	5	15.0	5
Geddes, S. Dak.	12	5	9	13.0	6–7
				13.5	9
Blair, Nebr.	19	8	13	21.1	12
Omaha, Nebr.	19	10	14	20.0	13
Nebraska City, Nebr.	15	1	17	20.3	13–14
Brownville, Nebr.	15	Mar. 28	17	20.9	14
Rulo, Nebr.	17	7	17	21.3	16
St. Joseph, Mo.	17	10	18	19.4	16
Atchison, Kans.	20	8	18	23.1	16–17
Leavenworth, Kans.	19	14	18	20.0	17
Waverly, Mo.	18	Mar. 30	1	19.2	Mar. 31
		11	19	19.3	17–18
Hermann, Mo.	21	2	2	21.0	2
St. Charles, Mo.	25	1	3	26.6	2

FLOOD STAGE REPORT FOR APRIL 1949—Continued

[All dates in April unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM—continued					
Ohio Basin					
	Feet			*Feet*	
Green: Lock No. 2, Rumsey, Ky.	34	Mar. 25	4	36.7	1
West Fork:					
Elliston, Ind.	18	Mar. 27	1	23.6	Mar. 29
Edwardsport, Ind.	12	Mar. 27	5	20.3	Mar. 31
East Fork: Williams, Ind.	10	Mar. 30	2	13.6	Mar. 31
White: Petersburg, Ind.	16	Mar. 27	6	22.5	1
Wabash:					
Mt. Carmel, Ill.	17	1	7	21.0	3
Grayville, Ill.				19.7	4
New Harmony, Ind.	15	1	7	16.4	4
South Chickamauga Creek: Chickamauga, Tenn.	10	Mar. 31	2	13.2	1
Ohio:					
Shawneetown, Ill.	33	Mar. 30	5	35.2	2
Dam No. 50, Fords Ferry, Ky.	34	Mar. 29	7	37.8	2
White Basin					
Black: Black Rock, Ark.	14	Mar. 10	12	22.1	Mar. 28
White:					
				35.3	Feb. 6
Clarendon, Ark.	26	Jan. 22	23	31.5	Feb. 27
				29.0	5
				33.9	Feb. 10
St. Charles, Ark.	25	Jan. 11	27	27.3	7
Arkansas Basin					
Neosho: Emporia, Kans.	22	10	11	23.8	10–11
Red Basin					
Ouachita: Monroe, La.	40	4	15	40.3	11–12
Black: Jonesville, La.	50	Feb. 13	23	51.8	Mar. 1–4
				51.9	2
Sulphur:					
		10	11	38.8	10
Hagansport, Tex.	38	26	27	39.9	26
		30	[3]	40.9	30
Naples, Tex.	22	Mar. 26	4	26.2	Mar. 31
McCartney Bridge, Tex.				24.2	4
Lower Mississippi Basin					
St. Francis:					
				22.8	Mar. 21, 22
Fisk, Mo.	20	Mar. 19	6	23.3	Mar. 29, 30
St. Francis, Ark.	18	Mar. 20	12	21.6	Mar. 7
Coldwater: Sarah, Miss.	18	13	15	21.0	13
Tallahatchie: Swan Lake, Miss.	26	Mar. 27	25	29.6	2
Yazoo:					
Greenwood, Miss.	35	1	13	37.2	6
Yazoo City, Miss.	29	Jan. 3	[3]	36.2	Feb. 10
				33.4	18
Mississippi:					
Caruthersville, Mo.	32	Mar. 31	9	34.9	5
Baton Rouge, La.	35	15	15	35.0	15
Atchafalaya Basin					
Atchafalaya:					
Melville, La.	37	8	18	37.4	15
				28.8	Feb. 25–Mar. 1
Atchafalaya, La.	25	Jan. 17	May 8	28.0	18–19
Morgan City, La.	[2] 6	Feb. 18	[3]	8.0	Mar. 21
WEST GULF OF MEXICO DRAINAGE					
Nezpique: Basile, La.	22	26	May 1	22.3	29
Calcasieu: Kinder, La.	16	12	14	16.8	13
		24	30	19.8	25
Sabine: Mineola, Tex.	14	Mar. 31	2	16.0	1
Neches: Evadale, Tex.	16	2	6	16.2	5
Trinity: Liberty, Tex.	24	23	26	25.6	24
Guadalupe:					
Gonzales, Tex.	20	26	28	29.3	27
Cuero, Tex.	23	28	30	26.2	28
Victoria, Tex.	21	25	May 2	28.4	30
Nueces:					
Cotulla, Tex.	15	25	25	15.8	25
Three Rivers, Tex.	37	26	30	39.1	27
Rio Grande:					
Rio Grande City, Tex.	21	24	24	21.4	24
		25	27	23.3	26
Hidalgo, Tex.	21	26	28	21.7	28
Mercedes, Tex.	21	24	30	23.6	28
Brownville, Tex.	18	26	May 1	19.0	30

[1] Provisional.
[2] Continued at end of month.
[3] Flood stage or higher reached intermittently.

CLIMATOLOGICAL DATA FOR APRIL 1949

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

[For description of tables and charts, see REVIEW, January 1943, p. 15]

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

As of January 1, 1949, dewpoint values below 32° F. and relative humidity values at temperatures below 32° F. are expressed with respect to water rather than with respect to ice, as used prior to that date. Therefore, these hygrometric values before and after January 1, 1949, cannot accurately be combined without necessary conversion.

Section	Temperature								Precipitation					
			Monthly extremes								Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	62.3	−1.2	Centreville	91	25	Valley Head	28	17	5.79	+1.16	Gulf Shores	11.79	Greensboro	1.08
Arizona	59.7	+1.8	Mohawk	108	23	Maverick	−8	2	.38	−.28	Pierce Ferry	1.35	11 stations	.00
Arkansas	60.0	−1.6	Nimrod Dam	92	25	2 stations	23	[1]2	2.75	−2.21	Alum Fork	6.58	Paragould	.43
California	59.6	+.8	3 stations	109	[1]23	Big Bear Lake Dam	8	1	.16	−1.39	Gasquet Ranger Station.	2.16	161 stations	.00
Colorado	45.6	+1.7	Holly	95	24	Lake Moraine	−10	3	1.14	−.65	Rye	2.82	Buna Vista	T
Florida	71.3	+1.3	Stuart	96	4	Glen Saint Mary	34	17	5.16	+2.15	De Funiak Springs	12.33	Stuart	.45
Georgia	62.6	−1.6	Eastman	91	25	Blairsville Exp. Sta	23	17	5.71	+1.87	Columbus	9.47	Waynesboro	2.63
Idaho	48.5	+3.3	Riggins RS	90	28	Chilly 4 SE	−2	14	.54	−.89	Burke 2 NNE	2.85	4 stations	.00
Illinois	51.6	−.9	Carlyle	88	23	Freeport	13	16	1.77	−1.79	Rockford CAA	3.00	New Burnside	.60
Indiana	50.6	−1.3	Seymour 1N	85	27	3 stations	23	[1]9	2.01	−1.60	Salamonia	3.47	Seymour 1N	.60
Iowa	49.3	+.4	Onawa	91	25	Fayette	4	16	1.32	−1.29	Harlan	2.65	Lake Park	.65
Kansas	54.1	−.7	St. Francis	94	24	Atwood	7	1	2.20	−.43	Topeka WBO	5.58	Elkhart	.33
Kentucky	53.9	−2.6	Princeton	86	23	Benham	22	17	3.52	−.48	Barbourville Water Works.	6.36	Lovelaceville	1.19
Louisiana	65.1	−2.1	Plain Dealing	91	25	2 stations	32	16	6.53	+1.82	Glenmora	10.15	Oak Ridge	1.38
Maryland-Delaware.	52.7	+.4	6 stations	87	[1]15	do	19	[1]10	2.77	−.75	Pikesville Police Barracks, Md.	4.69	Cumberland, Md	1.67
Michigan	44.4	+1.5	Vanderbilt St. Forest	84	30	Vanderbilt St. Forest	9	16	1.62	−.77	Sandusky	4.05	Grand Marais CAA	.07
Minnesota	45.0	+1.9	Winnebago	87	26	Meadowlands 2 NE	8	1	.74	−1.36	Farmington 3 NW	2.85	3 stations	T
Mississippi	63.1	−1.6	4 stations	90	[1]22	2 stations	31	[1]16	5.11	+.22	Pearlington	12.22	Ashland	2.08
Missouri	54.3	−1.1	Clinton	90	25	Ellsberry	21	19	1.66	−2.34	Carthage	3.14	St. Louis University	.68
Montana	48.7	+5.3	Mildred	94	28	West Yellowstone	2	1	.57	−.55	Red Lodge	2.27	6 stations	.00
Nebraska	50.6	+1.2	Big Springs	95	24	Imperial	8	1	1.53	−1.11	Valentine	3.15	Indianola	.55
Nevada	52.3	+4.0	Overton	103	24	Marlette Lake	0	1	.24	−.58	Mount Charleston Lodge.	1.06	4 stations	.00
New England	46.3	+2.6	2 stations	83	30	Tuckerman Ravine, N. H.	11	25	3.47	+.13	Tuckerman Ravine, N. H.	6.86	Clayton Lake, Maine	1.32
New Jersey	51.8	+2.0	do	86	[1]15	Layton 3 NW	19	5	3.73	+.12	Little Falls Water Co.	5.89	Deepwater	1.72
New Mexico	51.8	+.2	Carlsbad	96	27	Red River	0	5	.92	+.04	Lake Maloya	4.47	7 stations	.00
New York	45.6	+1.3	Dansville AP	86	30	Saranac Lake	14	1	3.33	+.30	Terry Clove	6.33	Linden	1.36
North Carolina	58.1	.0	Mount Gilead	88	23	Mount Mitchell	12	[1]16	4.46	+.88	Cedar Mountain	11.72	Nashville	1.96
North Dakota	46.3	+5.2	2 stations	94	[1]29	Willow City	0	1	.20	−1.51	Carson 2 SW	2.34	Tioga	.00
Ohio	48.9	−1.0	Ironton	86	26	Millport 2 NW	17	17	2.67	−.56	Centerburg Water Works.	5.34	New Lexington 1N	.92
Oklahoma	58.9	−1.6	Altus Dam	94	8	4 stations	22	[1]1	2.07	−1.43	Antlers Recorder	9.50	2 stations	.23
Oregon	50.1	+2.9	2 stations	89	[1]16	Fremont	10	3	.83	−1.15	Astoria	4.61	Owyhee Dam	.00
Pennsylvania	48.3	−.4	Newport	87	27	Putneyville 2 SE	11	2	3.65	+.19	Long Pond	5.91	Hollidaysburg	1.99
South Carolina	61.2	−1.4	Parr	90	18	Long Creek 2 N	25	17	5.06	−1.78	Jocassee	11.99	Charleston WB City	2.09
South Dakota	49.2	+3.2	Pickstown	93	26	Hardy Ranger Station	−1	1	1.16	−.19	Lead	3.01	Webster	.09
Tennessee	56.5	−2.3	2 stations	85	[1]23	2 stations	21	17	4.15	−.22	Sassafras Knob	7.46	Samburg	1.67
Texas	62.2	−3.9	do	104	14	do	23	[1]1	3.96	+1.05	Freeport	13.11	Brite Ranch	.00
Utah	51.7	+3.3	Hite	96	24	Bryce Canyon CAA	1	3	.52	−.61	Alton Storage gage	2.15	Callao	.00
Virginia	53.9	−.8	2 stations	89	[1]15	Big Meadows	18	17	3.50	+.22	Trout Dale	8.68	Chinoteague	1.19
Washington	49.8	+1.2	Richland 2 SW	88	18	Bumping Lake	10	1	1.30	−1.09	Quinault R. S	8.14	4 stations	.00
West Virginia	50.8	−1.1	4 stations	87	26	2 stations	18	10	3.52	−.01	Rainelle No. 1	5.91	Omps	1.00
Wisconsin	45.2	+1.4	Brule Island	88	12	Winter P. K. Reservoir.	5	16	1.64	−.86	2 stations	3.47	Port Wing	.28
Wyoming	45.6	+4.4	Red Bird	88	24	Lake Yellowstone	−10	1	.95	−.70	Alva	3.21	Pinedale	.05
Alaska	21.4	+7.7	2 stations	60	[1]1	Shungnak	−40	29	1.85	+.01	Latouche	14.35	2 stations	T
Hawaii (March)	67.9	−1.6	Kaanapali	88	20	Haleaka'a R. S	34	16	4.24	−4.36	Kukui	42.00	13 stations	.00
Puerto Rico	75.6	−.4	Dos Bocas	96	14	Garzas Dam Guineo Reservoir.	50	2	1.55	−2.43	San Lorenzo (Espino)	5.04	Arecibo (3)	.00

[1] Other dates also.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR APRIL 1949

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Extremes: Highest	Date	Lowest	Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [2]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed of fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset) number of days: Clear	Partly cloudy	Cloudy	Sky cover, tenths (sunrise to sunset)	Possible sunshine
NEW ENGLAND	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	°F.	°F.	°F.	°F.	°F.		°F.			°F.	%	In.	In.	In.			In.	In.	m. p.h.					0-3	4-7	8-10	0-10	%
									45.0	+3.7							68	3.61	+.2																
Caribou [3]	628	5	33	987.8	1,011.3	----	49	31	40.1	+4.5	73	13	22	25	744	29	69	2.11	−.7	.64	13	0	7.1	0	12.6	nnw.	----	----	----	----	----	----	----	6.6	----
Eastport	75	67	82	1,008.5	1,011.5	−2.4	49	36	42.6	+3.6	60	21	28	25	672	----	--	2.57	−.3	.70	12	2	.7	0	9.8	n.	41	e.	6	5	9	16	7.2	50
Portland, Me. [3]	103	6	43	1,009.1	1,011.7	−3.2	56	35	45.6	+5.5	73	23	26	29	585	37	73	3.72	+.3	1.61	11	2	.4	0	8.1	s.	53	e.	19	6	7	17	6.7	62
Concord [3]	289	5	45	999.7	1,012.1	−2.8	59	34	46.4	+4.8	80	22	20	1	556	32	61	2.77	.0	.92	11	1	T	0	8.4	wnw.	35	e.	6	6	9	15	7.1	42
Mt. Washington	6,274	5	37	799.9	1,016.3	----	29	17	23.3	−.1	45	13	3	25	1,252	----	--	6.53	−.4	2.65	6	2	34.3	2	35.1	nw.	----	----	----	2	6	22	8.2	28
Burlington [3]	403	6	51	999.7	1,012.3	−2.6	56	34	45.1	+1.8	78	22	21	1	596	36	71	2.34	+.2	.72	12	4	.2	0	8.9	s.	34	s.	22	5	10	15	7.0	39
Boston [3]	124	33	62	1,011.2	1,012.4	−2.5	59	42	50.8	+4.4	77	21	33	25	423	35	60	3.23	−.1	.78	14	2	T	0	13.4	sw.	50	e.	6	8	10	12	5.9	63
Nantucket [3]	12	4	34	1,012.9	1,013.1	−1.5	53	40	46.1	+2.7	60	27	30	18	567	40	81	4.45	+1.5	1.29	13	2	.0	0	15.0	sw.	50	se.	6	9	7	14	5.9	55
Block Island	26	11	46	1,012.2	1,012.9	−2.0	54	42	47.5	+3.5	66	14	35	17	528	41	80	3.42	−.1	1.13	14	2	.0	0	16.4	sw.	65	sw.	6	6	12	12	5.8	60
Providence [3]	159	65	60	1,006.8	1,012.9	−2.3	62	42	52.1	+5.5	78	21	34	25	386	36	62	5.17	+2.0	2.17	11	2	.0	0	10.1	wnw.	45	sw.	6	7	11	12	5.9	63
Hartford [3]	159	5	44	1,007.5	1,013.1	−2.1	62	39	50.4	+3.7	78	14	28	5	445	37	64	3.78	+.4	1.39	12	3	.0	0	10.5	s.	44	sw.	6	5	13	12	6.3	67
New Haven [3]	107	5	39	1,009.1	1,013.0	−2.6	58	41	49.6	+4.7	75	14	32	11	467	38	62	3.19	.0	1.06	6	2	.0	0	8.0	n.	34	se.	6	7	15	8	5.9	65
MIDDLE ATLANTIC									53.0	+2.0							62	2.95	−.1														6.1	
Albany [3]	97	6	40	1,002.0	1,012.5	−3.1	60	37	48.5	+4.1	80	30	26	5	494	34	61	2.35	+.2	.60	13	0	T	0	9.7	wnw.	35	w.	16	3	13	14	7.0	39
Binghamton [4]	871	57	79	982.7	1,013.9	−1.7	58	36	47.2	+1.9	80	30	25	5	530	34	68	2.84	+.4	.78	14	1	T	0	6.9	w.	26	sw.	15	7	8	15	6.5	55
New York [4]	314	415	454	1,012.5	1,014.2	−1.4	66	45	53.3	+3.9	78	27	35	17	356	37	58	3.84	+.6	1.23	13	3	.0	0	16.1	nw.	57	w.	6	8	11	11	5.9	62
Allentown [3]	385	4	58	1,000.0	1,014.3	----	62	38	50.2	+1.5	81	15	27	5	498	37	64	3.88	+.5	1.24	14	0	T	0	9.7	w.	----	----	----	8	10	12	5.9	----
Harrisburg [3]	374	30	49	1,001.4	1,014.3	−1.6	62	41	51.2	+.3	82	26	30	5	420	35	58	3.20	+.5	1.17	12	1	T	0	8.5	wnw.	38	nw.	23	9	7	14	6.3	66
Philadelphia [4]	114	174	150	1,013.2	1,014.1	−2.1	63	46	54.0	+1.9	83	15	37	17	335	39	61	2.46	−.6	.75	11	1	.0	0	8.4	w.	29	s.	15	9	11	10	5.5	58
Reading	323	47	306	1,002.4	1,014.6	−1.3	63	43	52.8	+2.0	80	15	33	5	371	----	--	4.34	+1.1	1.62	14	4	T	0	12.7	w.	51	e.	6	7	12	11	5.9	67
Scranton	805	72	104	984.4	1,013.9	−2.0	59	39	49.2	+1.1	78	15	28	5	471	----	--	3.85	+1.1	1.13	14	2	T	0	7.2	n.	26	nw.	24	8	10	12	5.8	48
Atlantic City	52	37	172	1,011.9	1,014.3	−1.6	58	45	51.4	+3.6	74	27	35	2	408	42	71	2.58	−.4	.57	11	1	T	0	16.3	w.	54	se.	6	9	7	14	6.1	64
Newark [3]	30	5	46	1,012.5	1,014.9	----	64	43	53.2	+3.0	85	15	34	5	364	38	59	4.13	+.4	1.19	12	3	.0	0	12.0	wsw.	----	----	----	9	10	11	6.0	----
Trenton	190	89	107	1,006.8	1,013.5	−2.1	62	43	53.0	+3.2	82	15	34	1	365	----	--	2.92	.0	.80	14	3	.5	0	10.1	sw.	36	nw.	23	11	6	13	5.8	65
Baltimore [4]	123	100	215	1,010.5	1,015.0	−.9	64	46	55.0	+1.4	85	15	37	17	312	39	60	2.44	−.9	.64	12	2	.0	0	11.2	se.	45	sw.	15	8	12	10	5.9	58
Washington [4]	112	56	100	1,012.5	1,015.0	−.9	65	46	55.4	+2.1	86	26	35	17	297	39	59	2.01	−1.3	.72	9	1	.0	0	8.3	s.	31	nw.	24	5	13	12	6.5	52
Cape Henry	18	8	54	1,014.2	1,014.9	−1.4	65	50	57.3	+2.7	87	15	42	5	248	----	--	1.37	−1.9	.49	11	2	.0	0	13.4	n.	40	n.	24	7	9	14	5.9	53
Lynchburg [3]	686	5	58	981.4	1,015.3	−1.0	65	43	54.2	−1.4	83	26	30	17	324	39	60	3.91	+1.0	1.12	11	3	T	0	7.8	ssw.	38	w.	15	8	8	14	6.3	60
Norfolk [4]	91	80	125	1,014.6	1,015.6	−1.0	67	50	58.8	+2.0	86	15	39	17	206	44	67	1.71	−1.5	.60	14	2	.0	0	10.5	n.	35	sw.	24	8	8	14	6.4	60
Richmond [4]	144	11	52	1,008.8	1,014.9	−1.4	67	46	56.6	.0	86	15	34	17	265	42	63	2.31	−1.2	.57	13	4	T	0	8.2	e.	39	sw.	15	8	9	13	6.0	64
SOUTH ATLANTIC									61.2	.0							67	4.05	+1.0														5.7	
Asheville	2,253	77	92	----	1,015.4	−1.2	65	43	54.2	+.3	83	26	27	17	322	41	--	4.14	+1.1	.92	11	3	T	0	9.5	nw.	35	nw.	24	6	10	14	6.9	61
Charlotte [4]	779	63	86	988.2	1,014.4	−2.2	69	49	59.0	−.8	84	23	33	17	200	44	63	5.48	+2.2	1.57	11	1	.0	0	8.1	sw.	32	nw.	24	9	9	12	6.1	67
Greensboro [3]	886	6	56	984.1	1,016.1	−.8	68	44	55.8	−.5	83	15	29	17	288	41	62	3.93	+.4	1.11	10	2	.0	0	10.0	sw.	36	sw.	15	10	6	14	6.2	57
Hatteras	11	5	47	1,015.2	1,015.8	−.5	66	55	60.6	+.8	73	15	45	17	145	54	78	4.15	+.6	1.75	11	4	.0	0	13.3	sw.	32	nw.	24	10	10	10	5.6	74
Raleigh [4]	376	5	71	1,000.0	1,015.9	−.7	70	48	58.8	−.6	85	27	32	17	211	45	68	2.39	−1.1	.70	10	2	.0	0	8.0	sw.	36	sw.	15	6	12	12	6.0	49
Wilmington	72	73	107	1,014.6	1,016.2	−.7	70	53	61.8	−.2	81	24	38	17	127	51	--	3.79	+1.1	1.09	11	3	T	0	10.8	sw.	37	s.	13	13	8	9	4.9	68
Charleston [4]	48	11	92	1,014.2	1,016.1	−.8	73	58	65.6	+1.1	85	24	44	17	59	52	69	2.09	−.4	.77	10	3	.0	0	11.7	sw.	42	e.	5	13	7	10	5.0	71
Columbia, S. C. [4]	347	70	91	1,007.8	1,015.9	−1.0	72	51	61.8	−1.5	85	23	35	17	137	47	64	5.26	+2.4	1.93	11	3	.0	0	10.0	ne.	33	sw.	8	14	5	11	5.2	60
Greenville, S. C. [3]	1,040	18	36	978.3	1,015.6	−1.0	68	48	58.2	−.4	86	23	32	17	221	43	62	5.77	+2.0	1.69	10	1	.0	0	10.2	ne.	66	nw.	24	12	4	14	5.6	63
Augusta [4]	182	62	77	1,000.7	1,016.0	−.3	74	52	63.0	−1.2	86	24	35	17	108	46	59	3.77	+.6	1.05	9	1	.0	0	7.0	w.	28	w.	8	11	6	13	5.5	63
Savannah [3]	65	19	51	1,014.9	1,015.0	−1.9	75	57	66.0	+1.7	87	8	38	17	53	54	69	2.96	+.4	1.42	12	3	.0	0	11.8	sw.	50	nw.	24	9	10	11	5.7	54
Jacksonville [4]	43	86	110	1,015.6	1,016.8	−.5	78	62	69.9	+1.2	89	24	46	17	14	59	75	4.86	+2.5	1.78	10	8	.0	0	9.3	w.	27	w.	13	8	7	15	6.2	53
FLORIDA PENINSULA									75.7	+2.2							70	2.93	+.7														5.4	
Key West [4]	21	10	64	1,015.6	1,016.3	+.4	84	73	78.6	+2.9	87	25	62	9	0	68	72	1.68	+.4	1.18	3	3	.0	0	9.3	e.	34	w.	6	12	16	2	4.5	74
Miami [4]	25	242	249	1,015.2	1,016.4	−.5	80	70	75.2	+1.3	86	13	56	17	0	65	71	4.41	+1.0	2.30	9	6	.0	0	13.8	s.	35	ne.	25	8	16	6	5.1	79
Tampa [3]	35	5	36	1,015.9	1,016.6	−.3	84	63	73.4	+2.5	90	22	49	17	3	60	68	2.70	+.7	1.41	9	5	.0	0	8.6	e.	43	s.	12	5	10	15	6.6	57
EAST GULF									64.2	−.7							70	7.13	+2.7														6.5	
Atlanta [3]	1,173	33	72	981.4	1,015.8	−.8	70	50	59.8	−1.3	83	24	35	17	180	45	64	6.99	+3.3	2.62	11	2	.0	0	12.8	e.	39	nw.	24	11	4	15	6.0	55
Macon [4]	370	79	87	1,003.1	1,015.9	−.7	73	52	62.4	−1.5	86	24	34	17	127	49	62	5.24	+2.1	2.20	11	5	.0	0	7.4	e.	25	nw.	24	10	7	13	6.2	56
Apalachicola	35	11	51	1,014.9	1,015.9	−1.0	74	62	68.2	+1.1	86	24	49	17	20	----	--	9.68	+6.9	4.08	9	6	.0	0	9.5	sw.	47	se.	26	8	7	15	5.9	71
Pensacola [4]	56	54	79	1,013.9	1,016.2	−.7	74	60	67.0	+.3	81	24	48	17	32	57	--	11.41	+7.4	5.30	15	8	.0	0	9.0	w.	26	ne.	11	7	7	16	6.4	67
Anniston	618	6	32	993.6	1,016.1	−.8	71	48	59.3	----	84	24	31	17	184	49	72	3.48	−.9	1.12	11	1	.0	0	7.2	ene.	----	----	----	9	4	17	9.2	----
Birmingham [3]	700	5	63	993.2	1,015.9	−1.0	71	50	60.5	−1.2	87	24	33	17	164	47	66	4.90	+.1	1.26	12	3	.0	0	10.5	ssw.	32	s.	10	9	5	16	6.1	53
Mobile [4]	57	86	161	1,007.8	1,015.9	−.7	75	59	67.0	+.7	88	24	43	17	38	57	76	10.69	+6.1	6.15	11	8	T	0	11.9	se.	59	n.	21	7	11	12	5.9	55
Montgomery [4]	218	92	105	1,008.1	1,015.8	−1.1	74	54	63.8	−1.5	86	24	42	17	89	52	70	4.18	−.1	1.40	14	0	.0	0	7.8	w.	31	se.	11	9	5	16	6.2	55
Meridian [4]	375	67	92	1,004.1	1,016.0	−.3	74	52	63.1	−.9	90	24	33	17	112	52	73	5.77	+1.0	1.65	12	5	T	0	7.5	s.	----	----	----	7	7	16	6.4	----
Vicksburg [4]	247	82	102	1,006.1	1,015.6	−.7	72	56	63.6	−2.0	85	25	45	16	108	53	--	4.67	−.5	3.08	11	6	T	0	8.7	nw.	27	n.	27	4	9	17	7.3	45
New Orleans, C. O.	53	76	84	1,013.5	----	----	76	61	68.3	−.5	86	24	52	6	32	----	--	9.72	+4.5	3.83	13	5	.0	0	6.6	se.	21	e.	1	6	10	14	6.2	65
New Orleans, A. P. [3]	30	6	52	1,013.5	1,015.6	−.7	76	59	67.3	----	86	26	43	17	45	58	76	8.78	----	----	11	8	.0	0	7.8	s.	----	----	----	5	11	14	6.6	----

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR APRIL 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Extremes: Highest	Date	Lowest	Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [6]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed of fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset) number of days: Clear	Partly cloudy	Cloudy	Sky cover,[7] tenths (sunrise to sunset)	Possible sunshine
WEST GULF	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	° F.	° F.	° F.	° F.	° F.		° F.			° F.	%	In.	In.	In.			In.	In.	m. p.h.					0-3	4-7	8-10	0-10	%
Shreveport [3]	181	5	64	1,008.8	1,015.6	+.4	74	54	64.2	−2.0	88	24	37	16	110	54	73 74	4.60 2.86	+1.2 −1.8	.90	11	5	.0	0	11.6	sse.	34	w.	9	6	6	18	7.1 7.0	45
Fort Smith [3]	463	6	30	998.3	1,015.0	+1.1	72	50	60.6	−1.2	89	24	35	16	185	46	61	3.78	−.2	3.13	8	5	.0	0	8.2	ene.	29	w.	14	9	5	16	6.5	68
Little Rock [3]	265	26	58	1,002.7	1,015.7	+.8	71	53	62.0	−.1	89	24	40	16	153	48	63	2.07	−3.1	.78	8	4	.0	0	9.5	nw.	31	sw.	6	6	7	17	6.7	51
Austin [3]	621	5	41	992.9	1,015.4	+1.9	74	53	63.5	−4.3	87	7	40	6	121	54	75	6.91	+2.6	2.55	15	8	.0	0	9.1	sw.	40	ne.	15	5	9	16	7.0	49
Brownsville [3]	20	5	54	1,010.2	1,012.7	+.2	81	65	72.8	−.9	89	14	48	6	18	64	78	1.49	−.2	.59	11	5	.0	0	13.4	se.	37	se.	30	4	8	18	7.3	40
Corpus Christi [3]	44	6	33	1,012.2	1,014.6	+1.1	77	61	69.0	.0	92	14	44	6	34	61	79	4.83	+3.0	1.37	11	9	T	0	12.5	sse.	46	w.	1	5	7	18	7.1	41
Dallas [3]	488	34	45	997.3	1,015.3	+1.4	72	54	63.4	−1.7	89	7	42	5	128	50	68	2.52	−1.7	.65	12	5	T	0	8.1	n.	34	s.	13	6	5	19	6.9	42
Fort Worth [3]	706	40	56	990.2	1,015.5	+2.0	73	54	63.6	−.5	91	7	42	3	124	49	64	2.47	−1.6	.66	19	3	.0	0	13.6	s.				6	5	19	7.2	
Galveston [4]	54	122	129	1,013.9	1,015.3	+.1	70	61	65.9	−2.8	80	28	48	5	60	61	83	5.76	+2.7	1.79	12	9	.0	0	13.0	e.	42	e.	19	6	6	18	7.0	39
Houston [4]	138	157	190	1,012.5	1,015.3	+.4	74	59	66.4	−2.9	85	27	47	5	72	58	78	6.53	+3.0	1.94	15	9	.0	0	10.4	se.	44	ne.	1	6	4	20	7.5	34
Laredo [3]	418	10	38	994.6	1,013.5	------	80	60	70.4	−4.8	99	14	44	5	36	56	66	7.66	+6.5	4.89	12	10	T	0	11.1	e.				4	8	18	7.1	
Palestine	510	64	72	997.3	------	------	72	55	63.5	−2.5	86	7	43	3	122	----	--	2.43	−2.0	.78	9	4	.0	0	7.2	s.	28	s.	25	4	6	20	7.7	52
Port Arthur [4]	34	59	134	1,014.2	1,015.2	.0	73	60	66.4	−2.1	82	28	48	16	66	59	82	6.11	+3.1	2.15	13	9	T	0	13.4	s.	43	ne.	20	6	4	20	7.2	47
San Antonio [3]	794	6	51	986.1	1,015.0	+1.8	75	55	64.6	−4.5	89	13	39	5	96	53	72	8.99	+5.8	2.06	12	9	.0	0	8.7	ne.	38	ne.	15	4	7	19	7.5	45
OHIO VALLEY AND TENNESSEE																	66	3.23	−.5														6.7	
Chattanooga [3]	762	6	66	990.9	1,015.9	−.7	69	48	58.2	+.6	84	23	30	17	217	46	67	4.96	+.1	1.73	11	2	.0	0	6.4	ne.	34	nw.	24	8	5	17	6.3	57
Knoxville [3]	995	27	71	980.7	1,015.9	−.4	67	47	56.8	−.5	80	23	30	17	260	43	64	4.04	−.1	2.10	12	2	T	0	11.4	ne.	36	sw.	7	6	9	15	6.7	54
Memphis [4]	399	5	49	1,005.1	1,015.5	−.4	67	52	59.8	−2.0	83	23	41	16	190	48	66	6.77	+2.0	5.26	10	2	.0	0	8.5	e.	31	sw.	14	7	7	16	6.6	59
Nashville [3]	546	5	72	993.9	1,015.7	−.9	66	47	56.9	−2.1	80	14	32	19	257	47	72	5.27	+1.1	2.37	11	3	.0	0	8.8	nne.	34	sw.	14	8	2	20	6.9	48
Lexington [3]	989	4	58	980.0	1,016.3	−.3	62	42	51.8	−2.5	79	26	30	17	393	41	69	3.34	−.2	.85	16	2	T	0	10.0	wnw.				4	10	16	7.0	
Louisville [3]	526	5	54	998.0	1,015.9	−.4	64	45	54.4	−.4	80	26	33	17	327	40	62	3.07	−.8	.85	14	3	T	0	8.8	nne.	56	sw.	15	7	6	17	6.9	55
Evansville [3]	431	6	40	1,002.0	1,016.3	+.4	63	44	53.7	−1.2	78	22	33	4	345	42	67	2.73	−1.2	1.40	9	3	T	0	9.2	wnw.	42	sw.	15	7	8	15	6.7	52
Indianapolis [3]	823	5	54	986.1	1,015.9	0	61	40	50.2	−.6	76	25	25	9	442	39	67	1.62	−2.0	.51	11	1	T	0	11.5	wnw.	49	w.	15	6	10	14	6.3	57
Terre Haute [3]	575	4	36	994.2	1,016.1	+.9	63	40	51.6	−.9	80	29	28	9	403	40	67	1.47	−2.2	.39	12	2	T	0	10.8	sse.	37	w.	15	8	9	13	6.1	65
Cincinnati [4]	627	135	148	984.1	1,016.2	−.1	63	45	53.8	−.5	82	26	34	16	342	38	63	1.76	−1.4	.29	16	1	T	0	5.3	nw.	18	nw.	7	5	9	16	6.8	56
Columbus [4]	822	90	110	985.4	1,015.8	−.1	60	42	50.6	−.6	78	26	31	4	429	38	68	2.84	.0	.96	15	3	T	0	9.9	n.	40	sw.	14	5	10	15	6.5	61
Dayton [3]	1,003	6	55	981.7	1,015.9	.0	59	39	49.0	−1.5	76	26	28	9	478	37	67	1.59	−1.6	.29	15	1	.2	0	12.0	e.	47	s.	14	3	12	15	6.8	56
Elkins [3]	1,947	5	45	944.1	1,015.9	−1.0	59	35	46.8	−.6	77	26	22	10	542	36	70	3.79	+.2	.81	16	3	T	0	7.7	w.	43	nw.	7	4	8	18	7.7	46
Parkersburg	637	77	84	------	------	------	63	41	51.8	−1.6	81	26	30	17	391	----	--	2.60	−.6	.76	11	2	T	0	7.2	se.	29	nw.	8	7	7	16	6.0	55
Pittsburgh [3]	842	39	54	969.9	1,015.2	−1.4	60	39	49.6	+.4	76	30	27	17	464	33	58	2.57	−.4	.82	17	4	1.3	0	10.7	sw.	40	w.	22	5	9	16	6.7	53
LOWER LAKES																	66	2.78	+.3														5.9	
Buffalo [3]	768	34	96	986.1	1,014.6	−1.0	55	36	46.4 45.5	+1.4 +1.7	82	30	26	17	583	33	68	2.42	−.1	.71	13	4	.5	0	13.2	sw.	47	sw.	26	7	9	14	6.3	65
Canton	448	10	61	996.3	1,012.5	−2.1	54	35	44.5	+2.6	75	22	24	1	614	32	66	4.24	+2.1	1.56	14	3	.8	0	8.2	w.	27	sw.	15	6	7	17	6.6	45
Oswego	335	71	85	1,000.7	1,013.5	−1.7	51	38	44.8	+2.2	75	22	31	16	606	----	--	3.41	+1.1	1.00	12	2	.2	0	9.0	w.	34	n.	27	11	6	13	5.8	53
Rochester [3]	523	4	69	993.6	1,014.2	−1.7	56	36	46.0	+1.1	79	30	26	17	570	33	66	2.11	−.2	.44	11	1	T	0	11.2	wsw.	56	w.	26	9	12	9	5.8	63
Syracuse [3]	596	5	57	999.0	1,014.1	−1.5	58	36	46.8	+3.8	79	30	26	25	547	34	65	3.60	+1.1	1.12	14	2	T	0	9.1	sw.	35	w.	23	7	10	13	6.6	51
Erie [4]	714	57	81	------	------	------	52	39	45.6	+.5	71	30	27	17	583	----	--	2.67	−.1	.88	16	3	.7	0	7.6	w.	29	w.	23	11	7	12	5.4	55
Cleveland [3]	762	27	54	987.5	1,015.5	−.1	58	37	47.4	+1.2	76	30	25	17	526	35	68	2.78	+.3	.61	16	3	.9	0	10.6	sw.	50	w.	23	8	10	12	5.9	59
Sandusky	629	5	67	992.6	------	------	56	40	47.7	+.5	73	27	30	17	523	----	--	2.96	+.4	.61	15	2	T	0	8.5	sw.	27	w.	23	10	9	11	5.3	59
Toledo [3]	628	5	47	992.2	1,015.5	−.4	58	36	47.0	+.9	74	30	25	4	536	35	67	2.52	−.1	.84	12	2	.8	0	10.9	ene.	42	nw.	23	9	9	12	5.6	70
Fort Wayne [3]	857	5	34	984.8	1,015.6	−.3	59	37	47.9	−.8	75	13	25	9	514	36	64	1.84	−1.2	.59	13	2	2.4	0	8.2	n.	42	sw.	14	6	15	9	6.0	68
Detroit [3]	730	5	77	992.6	1,015.6	−.3	58	37	47.2	+1.6	77	26	27	2	534	33	61	2.03	−.4	.86	12	2	.3	0	10.3	nw.	56	nw.	23	11	7	12	5.3	66
UPPER LAKES																	63	1.52	−.9														4.5	
Alpena	609	5	89	992.6	------	------	53	33	44.4 42.8	+3.1 +4.2	74	12	20	17	662	----	--	2.28	.0	1.11	6	1	10.4	0	10.8	nw.	32	ne.	15	12	9	9	4.9	72
Escanaba	612	51	72	993.2	------	------	50	33	41.4	+3.5	67	22	21	2	711	----	--	.97	−1.3	.37	6	0	2.3	0	12.4	s.	47	n.	15	16	5	9	4.2	68
Grand Rapids [4]	707	70	244	989.5	1,015.7	−.2	59	37	48.1	+1.1	78	30	27	17	507	32	62	1.73	−1.0	.81	9	0	1.6	0	10.5	sw.	60	sw.	26	15	8	7	4.0	74
Lansing [3]	878	5	90	983.4	1,015.6	.0	57	35	46.2	+.9	76	30	25	9	563	32	62	1.87	−.7	.93	10	2	.3	0	12.3	nw.	52	w.	23	14	8	8	4.4	72
Marquette	734	44	73	988.2	------	------	53	35	43.7	+5.9	80	12	22	2	641	----	--	.64	−1.8	.30	5	1	1.4	0	8.8	n.	30	sw.	29	10	10	10	5.6	66
Sault Sainte Marie [3]	614	10	52	988.5	1,015.7	−.6	51	29	40.0	+3.5	79	30	20	17	748	28	65	.60	−1.5	.41	7	1	T	0	11.0	nw.	38	nw.	13	10	8	12	5.4	70
Chicago [3]	673	5	38	993.2	1,016.1	+.2	59	37	47.8	+.9	75	30	26	16	515	34	61	2.14	−.4	1.25	10	3	.5	0	9.8	nne.	36	w.	23	13	8	9	4.6	72
Green Bay	617	5	32	993.6	------	------	56	34	44.6	+1.4	77	30	17	2	611	----	--	2.60	.0	1.63	8	2	4.1	0	8.5	n.	43	n.	14	16	10	4	3.6	74
Milwaukee [3]	681	33	66	990.5	1,016.4	+.8	54	35	44.8	+2.6	71	21	25	16	606	32	64	1.38	−1.3	.59	9	1	.3	0	11.6	sw.	37	w.	22	18	3	9	3.9	73
Duluth [4]	1,133	5	47	963.8	1,016.2	+.3	55	34	44.4	+7.4	78	29	24	16	620	30	65	.95	−1.1	.47	6	1	5.9	0	11.6	sw.	37	w.	22	18	3	9	3.9	73
NORTH DAKOTA																	60	.54	−1.1														5.2	
Fargo [3]	940	5	47	982.1	1,015.5	.0	60	33	47.8 46.8	+7.4 +6.2	85	30	20	24	554	32	61	.02	−2.2	.02	1	0	T	0	15.5	s.	42	w.	22	12	10	8	4.9	73
Bismarck [3]	1,677	5	41	954.6	1,014.9	−.7	64	34	48.9	+8.5	86	29	19	18	494	33	58	1.70	+.2	1.22	3	0	.0	0	12.6	sse.	57	nw.	22	13	6	11	5.1	75
Devils Lake	1,478	11	44	960.0	------	------	57	34	45.4	+6.6	85	29	15	1	592	----	--	.15	−1.4	.15	1	0	T	0	9.6	s.	35	nw.	22	11	12	7	4.6	72
Williston	1,878	42	50	946.2	------	------	64	36	50.2	+8.2	91	29	24	14	460	----	--	.29	−.9	.27	4	2	.0	0	8.4	w.	42	nw.	22	8	6	16	6.4	88
UPPER MISSISSIPPI																	62	1.47	−1.5														5.0	
Minneapolis-St. Paul [3]	919	43	74	985.1	1,016.4	+2.2	58	36	50.2 47.1	+.3 +.7	80	30	22	1	537	32	58	1.80	−.3	1.25	6	1	9.3	0	10.4	sw.	37	w.	23	14	9	7	4.5	72
La Crosse [3]	672	5	29	991.5	1,016.4	+1.5	59	34	46.8	+1.2	80	30	17	16	545	33	62	1.29	−1.1	.56	8	3	3.9	0	9.7	s.	50	w.	23	12	12	6	4.6	81
Madison [3]	974	27	39	984.4	1,016.7	+1.1	60	33	46.4	+1.0	77	30	16	16	560	33	63	1.10	−1.7	.56	8	3	3.2	0	10.4	ne.	47	w.	23	13	10	7	4.5	76
Charles City	1,015	10	51	980.4	1,017.6	+2.4	61	35	47.9	+1.5	89	25	22	16	513	----	--	1.54	−1.0	1.10	7	2	5.3	0	9.9	se.	28	nw.	23	17	9	4	3.3	78
Moline [3]	606	6	50	994.6	1,016.9	+1.7	62	37	49.4	+.6	82	25	25	16	471	34	58	1.10	−1.6	.77	8	1	1.1	0	9.9	e.	43	nw.	23	11	10	9	4.8	70
Des Moines [4]	860	5	99	981.7	1,016.9	+2.3	63	39	50.8	+.7	88	25	28	16	431	37	62	1.13	−1.8	.63	4	2	1.5	0	9.9	n.	38	n.	14	9	10	11	5.4	65
Dubuque	699	60	79	990.9	1,016.3	+1.1	61	38	49.4	+.8	81	25	26	16	471	34	62	1.94	−.9	1.16	8	3	5.8	0	6.0	nw.	26	nw.	23	13	10	7	4.6	77
Burlington [3]	702	4	36	990.5	1,016.6	+1.4	63	37	50.0	−1.4	85	25	22	16	440	37	62	1.23	−2.0	.76	8	0	.3	0	11.4	nw.	45	nw.	17	10	11	9	5.2	69
Cairo	357	5	99	1,002.7	------	------	67	50	58.4	−.7	82	23	36	16	218	----	--	.95	−2.8	.70	7	4	.0	0	9.1	ne.	35	w.	14	8	6	16	6.6	60
Peoria [3]	609	7	26	994.2	1,016.6	+1.0	62	39	50.6	+.7	79	25	26	16	434	36	61	2.75	−.6	.98	9	2	1.2	0	11.5	ene.	40	nw.	17	11	7	12	5.4	66
Springfield, Ill. [4]	636	5	49	993.6	1,014.9	.0	62	40	50.8	+.5	78	25	27	19	422	39	66	1.95	−1.6	.76	9	4	.1	0	12.3	nw.	40	sw.	14	11	7	12	5.5	65
St. Louis [4]	568	33	59	995.3	1,016.0	+.8	63	46	54.4	−1.7	82	22	33	16	321	40	62	.82	−3.0	.32	6	3	T	0	11.4	ne.	40	sw.	14	10	5	15	6.1	66

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR APRIL 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Extremes: Highest	Date	Lowest	Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [2]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed of fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset) number of days: Clear	Partly cloudy	Cloudy	Sky cover,[7] tenths (sunrise to sunset)	Possible sunshine
MISSOURI VALLEY	*Ft.*	*Ft.*	*Ft.*	*Mbs.*	*Mbs.*	*Mbs.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*		° *F.*			° *F.*	%	*In.*	*In.*	*In.*			*In.*	*In.*	*m. p.h.*					*0-3*	*4-7*	*8-10*	*0-10*	%
									52.6	+1.5							61	2.11	−.8															
Columbia, Mo.[4]	784	6	66	987.1	1,015.9	+1.3	65	43	54.0	−.8	86	25	29	16	338	39	63	2.70	−1.1	.93	8	3	.3	0	7.6	w.	34	w.	17	12	6	12	5.3	58
Kansas City [3]	963	38	76	988.8	1,016.3	+1.7	66	45	55.1	+.3	88	25	30	4	315	39	59	2.03	−1.5	1.44	8	3	T	0	8.2	sw.	49	nw.	14	9	8	13	5.8	55
St. Joseph [3]	967	5	51	986.1	1,016.1	+1.9	66	42	54.0	+.5	87	25	29	4	344	39	61	2.09	−1.1	.95	7	3	.3	0	11.2	s.	45	nw.	14	12	8	10	5.1	64
Springfield, Mo.[3]	1,324	5	50	969.9	1,016.1	+.2	68	44	55.8	+.6	84	25	27	4	325	41	65	1.75	−2.1	.73	9	4	T	0	9.1	nw.	49	ne.	14	10	7	13	6.1	59
Topeka [4]	987	65	87	984.1	1,016.4	+2.5	66	44	55.1	+.4	88	25	31	4	314	41	67	5.58	+2.8	2.55	7	3	T	0	9.0	s.	37	nw.	14	9	9	12	5.8	58
Lincoln [4]	1,189	6	81	973.2	1,016.4	+2.2	65	42	53.3	+1.8	86	25	30	1	358	37	62	1.29	−1.2	.65	5	0	1.5	0	9.6	n.	38	e.	30	13	5	12	5.2	70
Norfolk, Nebr.[3]	1,551	5	38	960.4	1,016.7	.....	63	38	50.5	+1.8	88	25	27	4	442	35	60	1.18	−1.5	.54	7	3	2.1	0	15.4	n.	...	.....	...	12	11	7	4.6	...
Omaha [3]	1,105	5	68	980.0	1,016.7	+2.1	64	41	52.8	+1.8	87	25	29	1	374	37	59	1.20	−1.3	.41	5	2	2.1	0	12.0	n.	46	n.	14	9	12	9	5.3	63
Valentine	2,598	46	54	923.8	1,015.9	+1.3	63	35	49.1	+3.4	88	24	19	1	478	35	55	3.15	+1.3	2.17	6	1	T	0	10.6	n.	32	s.	29	9	9	12	5.3	78
Sioux City [3]	1,138	5	40	976.3	1,016.7	+2.1	64	36	50.2	+3.0	89	25	27	4	450	36	62	1.79	−.9	1.17	6	2	6.2	0	11.1	nw.	37	s.	30	9	13	8	5.1	76
Huron [3]	1,301	5	41	969.2	1,016.4	+1.2	64	33	48.8	+3.7	82	30	20	18	488	33	59	.40	−1.8	.31	2	1	T	0	14.3	s.	56	se.	30	13	9	8	4.7	76
NORTHERN SLOPE									49.0	+5.0							50	.77	−.5														5.9	
Billings [3]	3,570	16	39	889.9	1,013.8	−1.4	66	39	52.8	+6.8	84	28	24	1	362	26	40	.74	.....	.37	4	0	.0	0	11.8	sw.	47	nw.	21	10	10	10	5.3	77
Butte	5,533	44	58	829.7	1,018.3	.....	58	26	42.1	+3.0	74	23	11	1	686	24	55	.64	−.4	.38	6	2	1.5	0	9.5	nw	...	.....	...	7	10	13	6.2	...
Glasgow	2,086	34	53	938.7	1,013.5	.....	69	36	52.4	+7.9	88	28	24	14	381	23	37	T	−1.0	T	0	0	.0	0	...	.....	...	.....	...	7	12	11	6.1	...
Great Falls [3]	3,657	16	75	887.2	1,014.0	.....	64	39	51.0	+5.3	79	18	29	9	418	24	39	.41	−.7	.30	3	0	T	0	16.3	sw.	54	sw.	20	7	9	14	6.6	70
Havre	2,507	11	67	924.8	1,013.9	−1.0	67	36	51.8	+8.1	86	28	24	2	398	...	...	.05	−.9	.05	2	1	.0	0	10.0	sw.	34	sw.	5	9	8	13	5.8	79
Helena [3]	4,124	5	43	873.4	1,016.2	+1.3	63	32	47.8	+4.3	80	23	20	1	519	27	49	.61	−.5	.26	4	1	T	0	9.3	w.	39	w.	20	8	12	10	6.0	77
Missoula [3]	3,263	4	32	902.8	1,017.7	+2.8	63	31	47.0	+3.1	79	27	22	1	539	29	54	.12	−.8	.09	3	0	T	0	6.1	w.	31	nw.	23	3	9	18	7.0	64
Kalispell	2,973	48	56	912.0	1,015.6	+1.0	59	35	47.0	+3.4	75	27	26	1	541	...	...	.58	−.2	.26	7	1	T	0	6.8	sw.	26	sw.	23	4	14	12	6.5	58
Miles City [3]	2,371	5	28	929.9	1,014.3	−1.6	67	38	52.4	.....	86	28	25	1	382	30	...	.29	.....	.28	3	0	T	0	10.2	sse.	...	.....	...	10	9	11	5.7	...
Rapid City [3]	3,259	5	56	901.8	1,015.1	−.5	64	35	49.8	+5.7	83	29	18	1	459	30	52	2.06	+.6	1.24	6	1	T	0	16.6	nnw.	56	nw.	20	9	9	12	5.4	79
Cheyenne [3]	6,094	22	40	810.4	1,014.9	+1.4	57	32	44.6	+3.7	76	23	18	15	611	29	60	1.61	−.4	.50	8	5	4.6	0	13.7	wnw.	45	n.	9	6	12	12	6.2	64
Lander [3]	5,352	6	30	828.0	1,014.2	+.3	62	35	48.4	+6.0	78	24	22	2	493	28	46	.99	−1.1	.62	4	0	5.4	0	7.8	sw.	43	sw.	29	10	10	10	5.2	70
Sheridan	3,790	5	38	877.8	1,014.9	.0	65	34	49.9	+6.6	83	28	20	1	451	30	50	2.30	+.4	1.27	7	1	3.3	0	9.9	nw.	38	nw.	29	12	8	10	5.1	70
North Platte [3]	2,821	11	51	917.7	1,016.0	+1.8	63	36	49.3	+.7	89	25	11	1	479	36	66	1.15	−.9	.35	8	4	.5	0	10.7	s.	49	n.	13	9	8	13	5.9	64
MIDDLE SLOPE									55.0	+.9							61	2.46	−.1														5.8	
Denver [4]	5,292	106	113	836.1	1,013.2	+.7	62	40	50.8	+3.7	85	24	25	2	435	29	52	1.15	−.9	.24	10	0	7.0	0	7.9	s.	40	n.	9	11	5	14	5.7	60
Pueblo [3]	4,690	5	36	852.4	1,013.3	+1.4	65	37	51.3	+1.9	88	25	20	3	411	32	55	.93	−.4	.30	9	1	4.2	0	7.5	nnw.	43	w.	30	9	9	12	5.8	58
Concordia	1,392	50	58	966.5	1,016.6	+2.4	64	43	53.6	+.1	83	25	30	1	345	39	64	2.86	+.5	.86	11	4	T	0	9.0	s.	47	nw.	14	15	3	12	4.7	64
Dodge City [3]	2,509	5	58	924.5	1,015.4	+1.9	65	42	53.6	.0	88	24	24	1	351	40	66	2.95	+1.0	1.44	10	4	.9	0	14.8	s.	59	n.	13	14	7	9	4.8	54
Wichita [3]	1,358	52	64	965.5	1,015.6	+2.4	66	46	56.0	−.4	86	24	30	1	293	42	63	3.85	+.9	1.78	8	7	1.5	0	15.1	s.	68	nw.	14	9	5	16	6.2	59
Oklahoma City [4]	1,214	10	47	968.5	1,015.8	+2.6	70	50	59.9	+.1	88	24	34	2	204	45	65	1.65	−1.6	.69	6	3	T	0	8.8	n.	23	s.	30	8	5	17	6.7	44
Tulsa [3]	674	10	60	991.2	1,015.5	.....	70	49	59.6	+.7	89	24	34	2	209	45	63	3.83	−.4	1.84	7	3	T	0	11.3	n.	40	nw.	14	9	6	15	6.7	61
SOUTHERN SLOPE									59.8	−2.7							63	2.42	+.5														6.5	
Abilene [3]	1,755	4	59	953.3	1,014.7	−.9	71	50	60.6	−2.4	92	13	33	5	188	45	65	3.05	+.3	1.77	12	7	T	0	11.8	n.	40	e.	19	5	8	17	6.8	59
Amarillo [3]	3,604	5	42	888.9	1,015.0	+2.8	66	42	53.8	.0	81	23	26	1	340	40	66	1.99	+.2	1.28	8	5	2.4	0	13.3	s.	35	sw.	30	8	10	12	6.0	70
Del Rio	960	63	71	979.7	1,013.5	−.4	76	56	66.0	−4.6	92	14	42	6	68	52	68	4.65	+2.9	2.02	13	8	.5	0	8.1	se.	32	e.	19	6	7	17	7.0	49
Roswell	3,614	6	29	891.0	1,013.8	+3.0	72	43	57.6	−3.0	92	26	29	5	238	36	52	.50	−.4	.21	8	4	1.0	0	9.1	se.	34	w.	13	10	8	12	5.7	57
Wichita Falls	1,030	4	49	978.0	1,015.1	.....	72	50	61.2	−3.7	92	7	34	3	169	46	63	1.92	−.7	.83	7	5	.1	0	13.2	n.	...	.....	...	7	3	20	6.9	...
SOUTHERN PLATEAU									63.3	+2.7							37	.26	−.3														4.4	
El Paso [3]	3,916	35	85	880.1	1,011.9	+1.7	76	48	62.1	−.2	90	26	28	5	152	30	34	.05	−.2	.04	2	3	T	0	10.2	sw.	66	nnw.	10	14	11	5	4.3	79
Albuquerque [3]	5,314	5	45	836.4	1,012.2	+2.0	69	42	55.5	+1.5	85	25	27	2	299	30	44	.67	+.1	.27	7	5	4.6	0	10.2	nnw.	42	se.	1	12	7	11	4.9	78
Flagstaff	6,907	34	48	790.7	1,015.9	+5.4	64	32	48.0	+4.7	77	23	15	1	516	23	43	.31	−1.0	.17	2	3	.4	0	6.5	nnw.	...	.....	...	10	12	8	5.3	...
Phoenix [4]	1,107	39	87	972.6	1,011.5	−.4	86	57	71.7	+4.7	102	23	40	2	36	36	34	.18	−.2	.18	1	0	.0	0	6.6	e.	22	w.	29	17	6	7	3.8	90
Tucson [3]	2,555	5	39	924.1	1,011.5	+1.3	82	52	67.4	+3.0	97	24	38	2	64	28	28	.38	.0	.24	4	0	.0	0	8.2	se.	33	e.	11	14	8	8	4.3	88
Yuma	142	9	54	1,006.1	1,011.3	+.1	90	59	74.9	.....	105	23	47	2	10	38	--	T	.....	T	0	0	.0	0	7.3	wnw.	30	nw.	7	16	7	7	3.7	92
MIDDLE PLATEAU									51.4	+4.7							48	.56	−.4														4.9	
Ely [3]	6,262	8	41	809.3	.....	.....	63	29	46.0	+5.6	75	23	15	15	569	...	...	.36	−.7	.29	4	2	.0	0	10.9	s.	33	n.	8	12	9	9	4.7	78
Reno [3]	4,527	20	52	866.9	1,016.8	+2.2	71	32	51.6	+5.5	81	10	17	1	403	27	45	.29	−.2	.15	2	1	.0	0	7.1	w.	38	nw.	12	12	8	10	5.0	83
Winnemucca	4,339	5	56	868.6	.....	.....	70	34	51.9	+5.2	82	23	20	1	391	...	...	.17	−.7	.09	4	1	.0	0	8.4	ne.	33	w.	28	13	6	11	4.6	72
Salt Lake City [3]	4,357	32	58	871.0	1,015.1	+1.9	67	40	53.6	+5.7	83	23	30	2	349	34	51	1.25	−.5	.94	5	1	T	T	8.6	sse.	49	nw.	12	12	6	12	5.2	80
Grand Junction [3]	4,602	5	26	851.7	1,014.8	+3.6	67	41	54.1	+1.7	83	24	32	15	331	31	47	.74	−.1	.53	6	4	T	0	7.1	ese.	37	nw.	20	11	9	10	5.2	71
NORTHERN PLATEAU									50.9	+2.7							51	.51	−.7														5.5	
Baker [4]	3,471	36	54	897.4	1,018.7	+2.1	63	33	48.0	+2.8	79	17	23	1	509	30	...	.82	−.3	.39	7	1	T	0	6.3	se.	26	sw.	23	11	9	10	5.1	70
Meacham	4,056	7	28	877.8	1,019.5	.....	56	33	44.6	.....	72	17	24	3	613	31	63	1.00	.....	.35	9	1	2.7	0	5.8	nw.	...	.....	...	7	9	14	6.3	...
Boise [3]	2,739	5	49	920.8	1,016.9	+1.7	68	38	53.4	+4.3	82	27	26	14	349	30	44	.09	−1.1	.05	3	0	.0	0	10.1	se.	43	nw.	28	13	6	11	4.9	79
Lewiston	1,436	4	23	964.8	1,016.3	.....	68	40	54.0	.....	82	17	32	1	331	36	52	1.29	.....	.68	7	1	.0	0	7.2	w.	...	.....	...	8	6	16	6.4	...
Pocatello [3]	4,478	5	31	863.5	1,016.6	+3.1	66	36	51.1	+6.2	80	23	22	1	416	26	42	.42	−1.0	.25	4	2	T	0	12.5	wsw.	47	sw.	12	14	10	6	4.2	86
Ellensburg [3]	1,735	5	58	955.0	1,016.8	.....	64	34	48.6	+.4	79	16	25	14	490	32	56	.14	−.3	.10	3	0	.0	0	12.7	nw.	...	.....	...	6	13	11	5.9	...
Spokane [3]	1,929	6	51	948.2	1,017.3	+1.7	62	36	49.2	+.8	78	17	28	1	474	30	50	.42	−.7	.19	4	0	T	0	8.8	ssw.	29	sw.	19	8	9	13	6.1	76
Walla Walla	991	57	65	981.4	1,018.0	+2.1	68	46	56.9	+3.8	83	17	37	1	254	36	...	.35	−1.2	.10	7	0	.0	0	6.0	s.	25	w.	23	12	9	9	4.7	68
Yakima [3]	1,076	4	54	978.0	1,017.7	+2.5	70	35	52.4	+.6	83	17	27	3	382	32	49	.04	−.5	.04	1	0	.0	0	8.3	w.	...	.....	...	6	12	12	6.0	...

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR APRIL 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean Maximum	Mean Minimum	Mean	Departure from normal	Temperature of the air: Extremes: Highest	Date	Lowest	Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed of fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset) Number of days: Clear	Partly cloudy	Cloudy	Sky cover,[7] tenths (sunrise to sunset)	Possible sunshine
NORTH PACIFIC COAST	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs	°F	°F	°F.	°F.	°F.		°F.			°F.	%	In.	In.	In.			In.	In.	m. p.h.					0-3	4-7	8-10	0-10	%
Kelso [2]	750	38	76						51.5	+2.4							67	1.47	−1.1															6.8	
North Head	211	5	55	1,012.5	1,020.3	+2.0	54	44	48.8	+1.3	75	14	38	3	486			2.26	−1.9	.53	17	0	.0	0	14.0	s.	55	s.	28	2	7	21	7.8	49
Seattle [4]	125	90	321	1,015.2	1,019.8	+2.5	60	44	51.8	+.7	73	14	39	3	396	41	70	1.23	−1.2	.48	12	1	T	0	8.2	s.	43	sw.	19	1	9	20	7.6	47
Tacoma	194	172	201	1,012.5	1,019.6	+2.0	59	43	51.0	+2.3	72	4	38	6	417			1.87	−.9	.48	11	2	T	0	7.5	n.	47	sw.	23	5	10	15	6.5	57
Tatoosh Island	86	5	61	1,016.3	1,019.5	+2.6	51	43	47.0	+.9	58	4	40	30	540	42	84	5.59	.01	1.36	17	0	T	0	13.4	sw.	61	s.	23	1	3	26	9.1	37
Burns	4,162	35	47	874.4	1,017.9		64	32	48.2	+3.9	78	16	22	14	503	27	47	.30	+4.4	.24	5	1	T	0					13	5	12	4.9	
Eugene [3]	433	4	35	1,006.1	1,020.4		65	40	52.6		80	4	30	3	376	43	74	.83		.39	7	0	.0	0	6.9	n.			8	9	13	6.1	
Medford [3]	1,329	29	58	971.2	1,019.2	+2.6	71	39	55.3	+3.2	86	14	29	3	291	39	59	.16	−1.2	.11	2	0	.0	0	5.4	nw.			9	11	10	5.6	
Portland, Oreg. [4]	154	68	106	1,013.9	1,020.2	+2.6	64	45	54.7	+2.9	76	4	38	3	307	42	70	.89	−2.0	.39	10	0	T	0	5.8	nw	23	w.	29	7	8	15	6.5	50
Roseburg	510	45	76	1,001.4	1,020.3	+2.0	67	42	54.7	+3.7	83	14	31	3	309	42	59	.79	−1.5	.31	7	0	.0	0	4.3	n.	18	s.	27	8	8	14	6.1	54
MIDDLE PACIFIC COAST																																			
Eureka	60	72	88	1,019.0			55	46	50.6	+.7	65	4	37	25	432		63	.13	−1.9						7.2	n.	28	n.	1	6	5	19	5.2 7.4	64
Red Bluff [3]	353	5	26	1,003.7	1,016.6		79	50	64.4	+5.4	89	13	44	1	55	41	47	.10	−1.6	.41	3	1	.0	0	6.7	nw.	23	nw.	29	13	9	8	4.6	90
Sacramento [4]	66	92	115	1,015.2	1,017.1	+1.5	76	49	62.4	+4.3	86	22	43	1	97	46	62	T	−1.5	.07	0	0	.0	0	7.0	s.	19	nw	20	16	10	4	3.6	89
San Francisco [4]	155	112	132	1,018.3	1,018.9	+2.0	63	48	55.6	+.6	75	11	46	10	280	46	79	T	−1.6	T	0	0	.0	0	10.2	w.	36	w.	1	12	11	7	5.0	72
SOUTH PACIFIC COAST																																			
Fresno [3]	327	5	34	1,006.4	1,016.7	+1.1	82	50	63.4 65.6	+3.9 +5.4	94	22	41	1	39	44	62 52	.03 .01	−.9 −.9	.01	1	0	.0	0	6.8	nw.	29	nw.	28	12	9	9	5.4 4.8	88
Los Angeles	338	236	263				73	53	63.3	+3.9	89	11	45	3	85			T	−1.0	T	0	0	.0	0	6.0	w.	23	nw.	6	8	12	10	5.5	64
San Diego [3]	87	20	55	1,014.6	1,016.4	+1.2	69	54	61.3	+2.3	85	11	45	3	117	50	72	.09	−.7	.07	2	0	.0	0	6.0	wnw.	18	nw.	20	6	12	12	6.0	53
WEST INDIES																																			
San Juan, P. R.	82	9	54	1,014.2	1,017.6		81	72	76.5	−.1	86	16	68	2	0			.94	−3.4	.38	11	0	0	.0	11.7	e.	31	e.	13	11	18	1	4.2	73
ALASKA																																			
Anchorage [3]	132	6	44	1,000.7	1,005.8		41	22	31.4	−4.0	51	21	1	4	1,010	23	70	.82	+.4	.31	10	0	16.4	T	4.4	nw.	16	n.	5	4	5	21	7.9	
Annette Island	113	5	53	1,007.1	1,011.2		45	38	41.0	−1.7	52	28	29	5	716	38	89	21.35	+13.1	2.78	28	0	.1	0	15.0	se.				0	2	28	9.6	
Barrow	29	5	27	1,015.6	1,016.3		−1	−18	−9.6	−9.2	10	30	−36	7	2,224	−16	66	.07	−.1	.05	3	0	1.2	16	7.9	e.	30	w.	8	17	10	3	3.0	
Bethel [3]	28	5	31	1,007.5	1,009.1		27	9	18.1	−8.8	43	18	−21	3	1,405	14	80	.50	.0	.21	6	0	5.3	9	9.0	nw.				9	5	16	6.2	
Cordova [3]	45	5	32	1,003.7	1,005.8		41	28	34.4	−.8	46	21	16	9	917	31	88	5.41	+2.0	1.11	23	0	19.5	6	4.3	se.				4	1	25	8.4	
Fairbanks [3]	455	5	63	990.2	1,007.8		37	11	23.8	−5.6	56	19	−19	8	1,232	20	78	.23	−.1	.09	5	0	5.8	T		n.	17	n.	21	5	12	13	6.6	
Galena	139	4	66	1,004.7	1,009.1		26	1	13.8	−7.0	45	19	−29	7	1,531	4	59	.28	+.1	.16	5	0	2.8	12		n.				13	6	11	4.9	
Gambell	32	5	32	1,011.5	1,012.5		18	9	13.7	−4.7	32	24	−5	1	1,541	10	83	.33	−.4	.09	12	0	3.3	16	16.5	nne.	34	ne.	18	6	4	20	7.3	
Juneau [3]	80	6	30	1,007.8	1,008.5		44	35	39.6	−.6	54	28	29	30	766	36	86	4.32	+1.2	.78	27	0	1.6	0		ese.	35	se.	5	0	2	28	9.6	
Kotzebue [3]	20	5	31	1,011.2	1,011.9		14	−8	3.2	−10.3	33	19	−22	1	1,849	5	78	.18	−.2	.05	9	0	1.8	15		ne.				13	3	14	4.8	
McGrath [3]	341	5	31	995.3	1,008.5		32	3	17.8	−7.0	49	19	−26	5	1,388	8	59	.17	−.2	.07	5	0	3.5	24		nw.				10	10	10	5.3	
Nome [3]	22	10	75	1,009.8	1,010.5		24	−1	11.2	−8.5	37	19	−26	2	1,566	7	78	.86	+.2	.53	6	0	8.6	37	8.4	ne.	31	e.	9	3	7	20	7.0	
Northway [3]	1,718	5	32	942.1	1,006.1		39	11	25.2	+.2	50	19	−11	2	1,199	16	65	.02	−.4	.01	2	0	.2	5	5.1	nw.				3	12	15	7.1	
HAWAII																																			
Honolulu [4]	38	86	98	1,019.3			76	68	71.8	−1.2	79	20	65	7	0			.62	−1.5	.17	16	0	.0	0	10.8	ne.	37	ne.	24	4	18	8	6.2	58

[1] Height of barometer cistern above mean sea level on Jan. 1, 1900, or when station was first established since Jan. 1, 1900. When station is moved to new location or airport, the pressure is reduced to the original elevation for homogeneity. These elevations do not represent the present station elevation in most cases.

[2] Data are from airport records. Pressures adjusted to original elevations according to note 1.

[3] Barometric hygrometric, wind, character of day, and average cloudiness data from airport records; remainder from city office records.

[4] Barometric and hygrometric data from airport records, remainder from city office records.

[5] Barometric, temperature, degree day, and hygrometric data from airport; remainder from city office records.

[6] As of Jan. 1, 1949, relative humidity values at temperatures below 32° F. are expressed with respect to water rather than with respect to ice, as used prior to that date. Therefore, these hygrometric values before and after Jan. 1, 1949, cannot accurately be combined without necessary conversion.

[7] As of Jan. 1, 1949, "Sky cover" has been substituted for "Average cloudiness" to include smoke, snow, etc., in addition to clouds that obscure the sky.

NOTE.—Unless otherwise indicated, data in table are city office records.

SEVERE STORMS FOR APRIL 1949

[The table hereunder contains such data as have been received concerning severe local storms that occurred during the month. A revised list will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Flour Bluff Community, Nueces County, Tex.	1	11:30 a. m.			$34,000	Hail and wind	Minor damage to crops. Glass broken in hundreds of autos. Several small buildings demolished. 1 airplane demolished and 3 others damaged. Hail light.
Starke, Clay County, Fla.	3	2-3 p. m.		0	10,000	Tornado	1 person injured. 1 home destroyed and 6 damaged; 2 other buildings destroyed and 2 damaged.
Berkshire County, Mass., Rutland and Bennington Counties, Vt., White Mountain region, N. H.	6	P. m.				Gales	Gales with gusts estimated as high as 100 m. p. h. at South Shaftsbury Airport, Vt., where hangar and 3 planes demolished. Electric services disrupted as many poles and trees were felled; roofs blown away; small buildings displaced or collapsed. Storm of type colloquially termed "sherkshire" in Pownal Valley of Vermont. Lightning and hail in some sections. Several inches of snow fell in Berkshires, northern New Hampshire and central Maine, impeding traffic.
Provincetown, Mass.	6				30,000	do	Winds of whole gale force produced unusually heavy seas in harbor and caused loss of 5 small boats; damaged several others; considerable damage to Monument Wharf.
Rhode Island, coastal area	6			1		Gales and rain	Southeast to southwest gale winds up to 65 m. p. h. with accompanying high tides caused extensive damage to fishing boats and shore properties. Power lines down and service interrupted. At Danielson, Conn., man electrocuted when aerial of radio set blown against power line.
Gloucester, Mass.	6			1		Gales	A fisherman swept overboard from trawler by high waves, and drowned.
New Hanover County, N. C.	7	8:50-8:56 p. m.			7,500	Hail	Hailstones 1 to 1½ inches in diameter. Severe damage to greenhouses in Wilmington. Some crop damage.
Pittsburgh, Pa.	7				1,000	Electrical	Lightning struck tower of Radio Station WPGH and demolished tuning equipment.
Lafayette County, south-central part, Mo.	10			1		do	Boy killed by lighting in field 6 miles southwest of Higginsville.
Montgomery, Ala.	11	5:35 a. m.			2,500	Thundersquall	1 small plane destroyed at Norman Bridge Airport; 1 damaged slightly at Allenport air field and another damaged slightly at Norman Bridge Airport. Also some minor building damage in Montgomery.
Flintstone (near), Walker County, Ga.	12	5:25-5:43 p. m.	100	0	3,000	Tornado	Path extended about 3 miles east-northeastward. Tore hole in roof and blew in walls of 1 home; otherwise building damage confined to roofs. Many trees blown down through rural section.
Meriwether County, southeastern part, Ga.	12	6:30-6:35 p. m.	100	1	150,000	do	Moved north-northeastward. Struck first on Pine Mountain destroying home and uprooting several large trees. Lifted and dipped to earth several times along 2-mile path through business and residential areas of Manchester. 1 person killed and 20 injured. Gasoline service station demolished. 3 business stores heavily damaged. 25 homes and 7 other buildings destroyed; 15 homes and 15 other buildings damaged. Many trees blown down. Power and telephone lines blown down, leaving town without services throughout night.
Zebulon, Ga.	12	7:10-7:15 p. m.	300-400	1	126,000	do	Moved northeastward along 8-mile path. 2 business houses, 10 homes, and 42 smaller buildings destroyed; moderate to heavy damages to 35 homes and 63 smaller buildings, including toppling of courthouse tower. Many trees, power and telephone lines blown down, disrupting electric and phone services throughout night. 3 persons injured.
Griffin, Ga.	12	7:30 p. m.		0	35,000	do	Moved eastward, blowing down a water tower and doing material damage to a textile mill in south Griffin, then lifted, striking again in east Griffin, heavily damaging a church and damaging 28 homes, also numerous smaller buildings. 5 persons injured.
Bethany Community (near McDonough), Ga.	12	7:45 p. m.		2		Wind (possibly tornadic).	Moved eastward to 3 miles east of McDonough. 2 persons killed and 5 injured. A large home, tenant house, and several smaller buildings destroyed; 4 buildings damaged. Small area affected.
Covington, Newton County, Ga.	12	9 p. m.		0		Tornadic	Only Red Cross report available on this storm. 3 homes and 16 other buildings destroyed; 6 homes damaged.
Hogansville, Ga.	12					do	Only Red Cross report available, which indicates 3 persons injured, 3 homes destroyed and 4 homes damaged.
Roanoke County, Va.	13	Noon				Hail	Windows broken.
Natural Bridge, Va.	13	12-1 p. m.				Rain	Highway inundated. Farm buildings half-covered with rising water.
Richmond, Va.	13	6 p. m.			500	Electrical	Lightning toppled chimney and knocked plaster loose in 1 residence.
Ponca City, Okla.	13	7:50 p. m.	200		1,500	Wind	Gusty winds caused damage to greenhouse and 5 residences.
Mount Vernon and vicinity, Ind.	14	1:20 p. m.	[1]3		5,000	Wind and hail	Hail stones up to ¾-inch in diameter.
Jefferson City, Mo.	14	2:30-9 p. m.			1,000	Wind	Shingles blown off roofs. 1 roof torn off. Rain and sleet accompanied wind, but did no damage.
Stewart's Creek Valley (near Glenville), W. Va.	14	3-4 p. m.			2,000	Flash flood	Garage washed away against bridge. Gardens damaged. Dirt road washed out. About half of monetary damage to gardens.
Wood and Ritchie Counties, W. Va.	14	Late afternoon				Rain and wind	Many gardens destroyed. Dirt roads damaged. Wind damage to several homes. Foundation for a new home washed away.
Greene County, Ind.	14	6:30 p. m.	15	0	5,000	Tornado	Moved northwest of Linton in northeastward path ½ mile long. Small funnel seen.
St. Louis County and city of St. Louis, Mo.	14-15	8 a. m., 14th to 1 p. m. 15th.				Thunderstorm and wind.	Thunderstorm in morning and high wind throughout day and night continuing into next day caused widespread property damage: felling trees and wires, breaking numerous plate-glass windows and damaging roofs, cornices, chimneys, and other sections of buildings and homes. Some damage reported in East St. Louis, Ill. Some power lines and streetcars disabled when struck by lightning during morning storm. A few homes struck by lightning, but no serious damage resulted.
Wisconsin, eastern portion	14-15	Night			50,000	Wind	Power lines, tree limbs, and signs broken at Milwaukee. Part of church steeple blown down, building damaged, and garage demolished at Green Bay.
West Plains and central Howell County, Mo.	14-15		[1]25		5,000	do	Damage confined to buildings in and around West Plains. 1 barn twisted on foundation, and roof blown of another. Other damage consisted mainly of shingles blown off roofs and other minor damage.
Nebraska, eastern portion	14-15		[1]75			Snow and winds	Heavy damp snow, ranging up to 8 inches. Wires in parts of northeast downed because of large quantity of clinging heavy snow; considerable interruption of power and communications.

See footnote at end of table.

SEVERE STORMS FOR APRIL 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Laquin and Shunk, (Schrader Creek), Pa.	15	11–11:10 a. m.	200	0	4,000	Tornado	Moved northeastward in narrow valley through abandoned lumber village and CCC camp. 2 fishermen picked up by tornado, suffered injuries when they fell to ground. 2 cars damaged when trees uprooted and toppled on them. Man had shirt ripped off and rest of clothes torn. Others had fishing tackle and catch carried away by tornado. Hail, preceding tornado, ⅝ to ¼ inch in diameter. Large barn carried across road and landed against home, breaking all winows. Valuable cow killed. Area affected 5 to 6 square miles. Loss of virgin timber, orchards, and buildings not included in total.
Harrisburg, Pa	15	11:30 a. m.–1:30 p. m.			3,600	Wind	Signboard blown over onto 2 parked cars. Two 4,000-volt high-tension wires blew together and pole set afire. Television tower toppled onto building roof.
Carlisle (near Brandtsville), Pa.	15	11:30 a. m.–1:30 p. m.			2,500	do	2 barns and 1 house unroofed. 9 telephone poles down. Several trees blown down and many branches snapped off.
Towanda, Pa	15	11:50 a. m.–12:45 p. m.				Hail and thunderstorm.	2 separate thundershowers. Hail averaged ½ inch in diameter, with largest 1¼ inches.
Richmond, Va	15	2 p. m			1,000	Wind	1 house unroofed. Concrete block wall in process of erection toppled, injuring 1 workman. Other minor damage.
West Palm Beach Airport, Fla.	15	3:46–3:57 p. m				Hail	Light to heavy hail fell over area approximately 6 by 8 miles including most of the city of West Palm Beach and extending southward. Stones of hen's egg size reported from some points. Some damage to gardens and truck crops.
Barre, Vt	15	Afternoon		1		Electrical	Lightning struck a house and barn, killing a farmhand in barn.
Barkhamstead, Conn	15	do		1		Electrical and rain	Pilot killed when plane crashed and exploded due either to lightning stroke or heavy rain.
Pittsfield, Maine	15	do				Electrical	20 registered Jersey cattle killed when lightning set barn afire.
Baltimore, Md	15	p. m				Wind	Strong winds blew ladder from side of a house, causing painter to fall. He suffered fractures of both arms, and head injuries.
Michigan, entire State	15	Day			26,000	Electrical	Widespread thunderstorm activity caused some local damage to property. Loss of $12,000 resulted at farm near Marshall when 2 barns, a hogpen, double corncrib, shed and farm equipment destroyed by fire, evidently caused by lightning. In addition, 2 horses killed. Near Homer a barn and farm equipment valued at $6,000 burned. House and barn near Bedford struck by lightning and practically destroyed; damage estimated at $8,000.
Reno, Nev	18	12:40–1:12 p. m	67	0		Tornado	A particularly heavy cumulus cloud to the north of Reno dropped a clearly defined funnel from its base. First touched ground in vicinity of dry lake about 15 miles north of city; moved slowly eastward across low divide between Lemon Valley and Spanish Springs Valley, crossed Spanish Springs Valley in an east-northeastward direction, and finally broke up on the eastern side of Spanish Springs Valley. Entire path approximately 12 miles long and laid roughly across Reno Sky Ranch about center of Spanish Springs Valley. Funnel clearly visible from all parts of city and seen by many people. Twisted and torn juniper trees and desert sage showed that tornado was sufficiently well developed to have destroyed buildings, although none in its path. No damage, except removal of a skylight from south hangar of Reno Sky Ranch. Tornado immediately followed by heavy hail, which averaged about ¼ inch in diameter and covered ground to depth of about ½ inch . No damage by hail.
San Angelo, Tex	18	9:05 p. m	[1] 10-20		125,000	Hail	Stripped fruit trees, battered truck gardens, and damaged some roofs. 2 airplanes at North Concho Field badly damaged. Heavy hail; average size ½ inch in diameter. Accompanying rain of considerable benefit to surviving crops; probably offsetting damage of $50,000 to crops.
Shallowater area, Lubbock County, Tex.	18	9:30 p. m		0	5,000	Tornado and hail	Hail light. Roof lifted, house demolished, and barn damaged. All loss estimated to be from tornado.
Tatum, Lea County, N. Mex.	18	10 p. m			1,000	Hail	
Del Rio, Tex	19	12:55 a. m	[1] 3		1,525,000	do	Damage to crops, $15,000; livestock and poultry, $10,000; to buildings and other property, $1,500,000. Fruit crop totally destroyed. Public schools suffered loss of about 3,000 window panes and damage to roofs and interiors estimated about $60,000. Approximately 1,000 cars damaged at an average of $300 per car. Average hailstone, 1 inch.
Chaves County, southeastern part, N. Mex.	20	Afternoon			22,500	Rain and hail	Estimated 10,000 acres of cotton to be replanted.
Mobile, Ala	21	5:30–6:45 p. m			10,000	Thundersquall	Damage due to wind and water combined. Maximum wind for 5 minutes, 40 m. p. h.; extreme, 59 m. p. h. 3.51 inches of rain fell in an hour. Many sections of town flooded, with water damage in stores.
Sedalia, southern part, Mo.	22	7–7:10 p. m	2 blocks			Wind	Called by local newspaper a "small tornado." Destroyed 2 garages; pushed back shingles on roofs of 2 buildings; ripped down 8 telephone wires and tore off cross arms on telephone poles.
Sandia, Nueces County, Tex	23	12 a. m			1,000	Hail and wind	Hail light. Airplane damaged at Cuddihy Field by high wind.
Puget Sound—Olympic Peninsula, Wash.	23	8 a. m.–10 p. m		4		Wind	Storm winds, accompanying a large disturbance, did widespread but relatively light damage to communication and power lines. 3 men drowned in Lake Crescent due to capsized fishing boats. One death near Bremerton due to falling tree. Some cornices and brickwork, weakened by earthquake of Apr. 13 in Seattle, were loosened or brought down by winds. Property damage relatively light. At Seattle Weather Bureau Office winds reached a maximum of 38 m. p. h. from south at 1:38 p. m.
Pasquotank County, N. C.	23	3–3:40 p. m			750	Hail	Damage mostly to cabbage around Elizabeth City.
Scotland Neck, Halifax County, N. C.	23	6–6:20 p. m				do	Damage to crops and windows.
Baltimore County, Md	24	10:30 a. m		3		Wind	14-foot outboard motor boat capsized on Chesapeake Bay near Miller Island just to north of mouth of Patapsco River; 2 men and a 5-year-old boy drowned.
Epsom, Vance County, N.C.	24	Early afternoon				do	Tin roofing blown off. Falling trees disrupted telephone and electrical service.
Jordan Dam and Buyck, Elmore County, Ala.	24	3 p. m			10,000	Thundersquall	Wind damage to buildings. Considerable hail, diameter of a dime.
Whitehall (near), Wis	25	8 p. m			15,000	Wind	3 barns partly demolished. 1 ski jump partly blown down.
Renville, LeSueur and Rice Counties, Minn.	25	P. m		0	75,000	Thundersqualls (possibly small tornadoes).	Storm moved southeastward, accompanied by heavy rain and hail. A number of barns, outbuildings, silos, and windmills demolished. Farm and town houses, buildings, and farm machinery damaged. Trees uprooted. Poles and wires downed. 5 head of livestock perished. 1 person injured.
Greenwood County, Kans	26	12:30 p. m		0		Tornado	Vortex cloud seen 3 miles west and 1 north of Climax. Cloud dipped to ground twice and disappeared.
Holmes County, Miss	26	Early afternoon			15,000	Wind	1 home destroyed and 4 others damaged.

See footnote at end of table.

SEVERE STORMS FOR APRIL 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Hamilton, Kearny, and Finney Counties, Kans.	26	4:10–5:30 p. m.		0	900,000	Hail and tornado	Chief damage at and in vicinity of Lakin. 4 planes virtually destroyed at Lakin Airport. Much damage to window glass and roofs in town. Some hailstones reported as large as baseballs. Considerable damage to crops. Tornado clouds reported at and near Lakin, but apparently did not reach ground.
Meade and Clark Counties, Kans.	26	6 p. m.	[1] 1½		5,000	Hail	In southeastern Meade and southwestern Clark Counties, near Englewood. Damage mostly to wheat.
Stanton County, Kans.	26	6 p. m.	[1] 8		25,000	do	Mostly in eastern part of county over path 11 miles long. Damage to wheat. Some hailstones as large as tennis balls.
Buffalo and vicinity, Harper County, Okla.	26	6:30 p. m.			15,000	do	About $5,000 damage to wheat, and $10,000 damage to automobiles and buildings in an area 5 miles by 20 miles.
Hogansville, Ga.	27	4:45–5 p. m.	400		3,500	Wind	Moved east-northeastward and limited to local area about 400 yards square. Numerous small homes damaged. Roof of 1 business house partly blown off, causing much damage to stored stock. 1 automobile heavily damaged. Numerous trees blown down. Power and telephone services temporarily disrupted.
Hobbs, N. Mex.	27	5 p. m.			75,000	Hail	Unusually large stones, reported up to 3½ inches in diameter. Principal damage to electric signs, windows, roofs, light and power lines.
Corpus Christi, Tex.	28	10:30 a. m.	5–7	0	3,000	Tornado	In small area at North Beach. Several boats damaged. Tin roof torn. Water drains ripped from roof. Trailer top damaged.
Kermit, Winkler County, Tex.	28					Hail and wind	Damage estimated at several thousand dollars in the city's worst hailstorm.
Sanford, Fla.	29	4:30 p. m.			500	Wind and hail	High wind accompanying a thunderstorm damaged some roofs.
Kearny and Finney Counties, Kans.	30	Noon to 3:15 p. m.			135,000	Hail	From near Lakin to a point northeast of Garden City. Damage mostly to wheat.
Logan and Thomas Counties, Kans.	30	1:30–5:30 p. m.	[1] 2–6		50,000	do	In northern Logan and southern Thomas Counties over path about 35 miles long. Chief damage to wheat.
Kearny and Finney Counties, Kans.	30	2–2:30 p. m.		0	10,000	Tornado	Originated short distance north of Lakin. Path ended 20 miles northeast of Garden City. Several vortex clouds seen. No towns struck. No persons injured. Damage to rural property.
Wichita County, Kans.	30	2 and 4 p. m.			25,000	Hail	10 miles west of Leoti near Selkirk at 2 p. m. In northern part of county at 4 p. m. Damage to wheat.
Midway community (5 miles east and ½ mile south of Eldorado), Jackson County, Okla.	30	2:45 p. m.		0	1,000	Tornado	Storm moved northeast for about ½ mile in narrow path. Vacant house destroyed.
McClain, Cleveland, Pottawatomie, and Lincoln Counties, Okla.	30	2:57–after 4:55 p. m.	250	3	800,000	Tornado and hail	Path not continuous. Storm began 5 miles northeast of Blanchard; moved northeastward to north campus of University at Norman where it hit at 2:57 p. m. Rate of movement about 15 m. p. h. After leaving Norman Campus storm turned to its left and moved north-northeastward for about 8 miles striking the Hollywood Farm, then turned northeastward to 4 miles east of Stella then through Shawnee Lake area, south of McLoud and Dale at 4:55 p. m. and into Lincoln County through Crescent School east of Meeker and Payson. 48 persons injured near Norman and 8 in Pottawatomie and Lincoln Counties. 31 buildings, 12 vehicles, and 10 airplanes damaged near Norman. 9 farm homes destroyed in Cleveland County. Crescent School severely damaged and house nearby destroyed. 3 houses damaged at Payson. 2 deaths near Crescent School when tornado struck automobile and demolished it. 1 death near Shawnee Lake. Most of damage to University property near Norman, estimated at $600,000.
Scott and Lane Counties, Kans.	30	3–3:30 p. m.			100,000	Hail	Scattered areas in Scott County, and southeast of Dighton, in Lane County. Damage to wheat.
Comanche and Grady Counties, Okla.	30	3–4:30 p. m.	200–300	0	20,000	Tornado	Several farmsteads damaged northeast of Lawton. 2 semi-trailer trucks overturned on highway. Near Agawam and west of Richland in southern Grady County, 5 farm homes destroyed. School near Marlow destroyed; 4 persons injured. Path 30 miles long in northeastward direction.
Logan County, Kans.	30	3:30 p. m.		0	2,500	do	Vortex cloud seen at Oakley during rainstorm. Path not well defined. Extended from a mile west of Oakley to a mile east of that town. Roof of flower shop and uncompleted hall of Veterans of Foreign Wars damaged in Oakley.
Jackson County, Okla.	30	3:45–5 p. m.			25,000	Hail	Hail damage to wheat, offset to a large extent by benefits from needed rains in area south of Altus near Olustee and Friendship.
Tillman County, Okla.	30	3:45–5 p. m.	440	0	100,000	Tornado and hail	6 different funnels sighted northeast and northwest of Frederick and east of Davidson. 1 injury. Persons took to their caves. About $95,000 damage to farmsteads. $5,000 hail damage to wheat.
Garvin and McClain Counties, Okla.	30	4:30–6:45 p. m.	150	0	39,000	Tornado	Storm moved northeastward from southeast of Lindsay through Maysville and Wayne for about 25 miles, touching ground at intervals. 1 injury.
Econtuchka, Pottawatomie, County, Okla.	30	4:45 p. m.	2,250	0	10,000	do	No injuries. Storm damaged or destroyed 8 homes as it moved northward over path about 8 miles long.
Duncan (12 miles east of), Stephens County, Okla.	30	5:20 p. m.	300	0	6,000	do	Moved northeastward. Struck Omaraca Camp, but no injuries.
Mitchell County, Kans.	30	5:30–7 p. m.			2,000	Hail	In several parts of county. Hailstones small.
Bryan and Choctaw Counties, Okla.	30	5:31 p. m.	440	1	25,000	Tornado and hail	Northeastward path about 55 miles long from near Utica to Bennington to Nelson community; 3 injured; death near Utica; 6 homes near and at Bennington damaged.
Hodgeman County, Kans.	30	6 p. m.	880	0		Tornado	14 miles southeast of Jetmore, a short distance east of Highway No. 283. Path 5 miles long. Slight damage at 3 farmsteads.
Choctaw and Pushmataha Counties, Okla.	30	6–7:30 p. m.	1,760	2	603,000	do	Northeastward path, not continuous, from southwest of Boswell near Soper to Spencerville for about 50 miles parallel and about 10 miles to the south of tornado in Bryan and Choctaw Counties listed above. 6 injured. 1 death in southern Pushmataha County, 1 at Spencerville.
Bonham, Fannin County, Tex.	30	6:55 p. m.	50	3	75,000	Tornado, hail, and wind.	Only slight hail damage. Most of damage from tornado. Homes, barns, business houses levelled or twisted off foundations. Trees uprooted. Crops damaged by flying debris. 9 persons injured. 1 death due to heart attack (not included in those killed).

[1] Miles instead of yards.

SOLAR RADIATION DATA FOR APRIL 1949

Explanation of Tables 1 and 2 and references to descriptions of instruments, stations, and methods of observation, and to summaries of data, are given in the MONTHLY WEATHER REVIEW, vol. 72, No. 1, January 1944, p. 43. A list of pyrheliometric stations is given on page 45 of that issue. An explanation of the formula used in computing the air mass values for each station listed in Table 1 appears in vol. 75, No. 3, March 1947, p. 47.

Eppley 10-junction 180° pyrheliometers have been installed at the Weather Bureau offices in San Antonio and Fort Worth, Tex. and Las Vegas, Nev. A Brown electronic strip-chart recorder is used to obtain hourly values of total solar and sky radiation received on a horizontal surface at Fort Worth, while Brown integrating potentiometers are used at San Antonio and Las Vegas to obtain daily values of the radiation received on a horizontal surface. Beginning with this issue, daily values expressed in langleys will appear regularly in Table 2.

The latitude of San Antonio is 29°12′ N., the longitude is 98°28′ W., and the elevation of the pyrheliometer is 242 meters m. s. l.; the coordinates for Fort Worth are latitude 32°49′ N., longitude 97°21′ W., elevation 219 meters m. s. l.; for Las Vegas latitude 36°05′ N., longitude 115°10′ W., elevation 667 meters m. s. l.

At Fort Worth the instrument is very slightly shaded from the north by the control tower, a building wall, and instrument shelter, with other minor obstructions to the horizon consisting of distant flag and antenna poles, refinery stacks, downtown buildings, a water tower, and standpipes. With the exception of the control tower, all obstructions are low on the horizon. At Las Vegas, a distant flagpole and antenna to the north cause inappreciable shading of the pyrheliometer. The mountains surrounding the station, ranging in altitude from 0.1° to 3.1° on the horizon, delay sunrise and hasten sunset very slightly.

TABLE 1.—*Solar radiation intensities during April 1949*

[Gram calories per minute per square centimeter of normal surface]

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a. m.[1]	1:30 p. m.[1]
MADISON, WIS.											
	Air mass										
	4.81	3.84	2.88	1.92	*0.96	1.92	2.88	3.84	4.81		
April	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
1	0.75	0.90	1.03	1.24	1.46	------	------	------	------	3.8	4.4
2	.81	.96	1.10	1.26	1.51	------	------	------	------	4.2	4.4
4	.71	.90	.98	1.19	1.46	1.15	------	------	------	4.4	4.0
6	------	------	------	1.15	1.40	------	------	------	------	6.4	6.9
7	.77	.87	1.02	1.24	------	1.15	------	------	------	6.1	4.6
8	.84	.96	1.10	1.25	------	------	------	------	------	4.8	5.8
9	.59	.81	.96	1.24	1.37	------	------	------	------	3.8	4.4
11	.66	.74	.84	.94	1.34	------	------	------	------	5.3	5.6
12	.47	.59	.74	.95	1.22	.96	------	------	------	5.6	6.9
13	.50	.59	.75	.95	1.22	.91	------	------	------	6.6	9.1
16	.90	1.02	1.13	1.28	1.46	------	------	------	------	2.2	4.2
19	.75	.87	1.01	1.16	1.39	------	------	------	------	5.6	5.6
20	.55	.71	.80	.98	1.21	------	------	------	------	6.6	7.8
21	.49	.62	.73	.90	1.31	------	------	------	------	8.1	6.9
22	------	------	.94	1.11	1.43	------	------	------	------	11.0	7.8
23	------	------	.69	.84	------	------	------	------	------	7.8	5.3
27	.43	.62	.77	.96	1.35	------	------	------	------	8.1	8.1
28	.69	.87	.99	1.13	1.39	------	------	------	------	6.1	5.3
29	.64	.74	.87	1.07	1.39	------	------	------	------	6.6	5.8
30	.41	.54	.69	.81	------	------	------	------	------	8.4	10.6
Means	.64	.78	.90	1.08	1.37	1.04	------	------	------	------	------
Departures	−.05	−.06	−.09	−.09	−.03	−.14	------	------	------	------	------

TABLE 1.—*Solar radiation intensities during April 1949*—Con.

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a. m.[1]	1:30 p. m.[1]
BLUE HILL, MASS.											
	Air mass										
	4.86	3.89	2.92	1.94	*0.97	1.94	2.92	3.89	4.86		
April	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
1	------	------	------	------	------	1.36	------	0.75	------	4.4	5.1
2	0.84	0.97	------	------	------	1.12	------	------	------	5.7	4.9
5	.80	.91	1.04	1.26	------	------	------	------	------	4.6	4.9
9	.82	------	1.04	------	------	------	------	------	------	6.7	4.3
10	.93	1.04	1.15	1.30	------	------	------	------	------	5.0	4.5
11	------	------	------	------	------	1.17	1.03	.93	0.84	5.2	3.7
12	.84	.94	1.08	1.20	1.42	1.04	.84	.65	.52	4.6	5.2
13	------	------	------	1.19	------	------	------	------	------	10.0	11.5
14	------	------	------	------	------	------	.68	.54	.39	11.0	14.8
19	------	------	------	------	------	1.10	------	------	------	11.7	6.5
20	.69	.77	.91	1.15	------	1.06	.88	.76	.62	6.8	6.2
21	.49	.60	.81	1.00	1.36	------	------	------	------	6.0	7.1
22	.60	.71	.84	1.04	1.20	------	------	------	------	7.9	6.7
23	.79	.92	1.07	1.25	1.40	------	------	------	------	9.4	8.2
24	.68	.84	1.02	1.19	------	------	------	------	------	9.1	8.2
25	.77	.84	.96	1.07	1.49	------	------	------	------	2.8	2.7
27	------	------	------	------	------	------	.89	------	------	12.7	9.3
28	------	.78	.98	1.19	1.50	1.27	1.09	.96	.85	8.4	4.3
29	1.00	1.09	1.18	1.27	------	------	------	------	------	3.7	3.3
30	.57	.67	.80	1.05	------	.72	.45	.32	.26	7.6	7.2
Means	.76	.85	.99	1.17	1.40	1.10	.84	.70	.58	------	------
Departures	−.03	−.04	−.04	−.02	.00	−.04	−.11	−.12	−.11	------	------
LINCOLN, NEBR.											
	Air mass										
	4.77	3.81	2.86	1.91	*0.95	1.91	2.86	3.81	4.77		
April	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
6	------	------	------	------	1.30	1.01	0.66	------	------	6.1	7.4
7	------	------	------	1.05	1.33	1.14	.99	.86	.75	7.4	7.2
11	------	------	0.86	1.11	1.35	1.09	.94	.79	.70	5.6	4.8
12	------	------	.88	1.07	1.32	1.10	.94	------	------	6.6	9.1
18	------	------	------	1.24	1.42	1.20	1.03	.92	------	4.6	4.2
23	------	------	------	------	1.37	1.14	.99	.84	.73	6.6	5.8
Means	------	------	.87	1.12	1.35	1.11	.96	.85	.73	------	------
Departures	------	------	−.10	−.06	−.10	−.06	.00	+.02	+.03	------	------
TABLE MOUNTAIN, CALIF.											
	Air mass										
	3.76	3.01	2.26	1.51	*0.75	1.51	2.26	3.01	3.76		
April	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
4	------	------	------	1.36	------	------	------	------	------	------	------
10	1.11	1.21	1.31	1.45	------	------	------	------	------	------	------
12	------	------	------	1.40	------	------	------	------	------	------	------
13	------	------	------	1.38	------	------	------	------	------	------	------
14	------	------	------	1.38	------	------	------	------	------	------	------
15	------	------	------	1.36	------	------	------	------	------	------	------
Means	1.11	1.21	1.31	1.39	------	------	------	------	------	------	------
Departures	+.03	+.04	+.03	−.01	------	------	------	------	------	------	------
BOSTON, MASS.											
	Air mass										
	4.96	3.96	2.97	1.98	*0.99	1.98	2.97	3.96	4.96		
April	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
12	------	------	------	1.17	------	1.06	------	------	------	7.4	7.4
Means	------	------	------	1.17	------	1.06	------	------	------	------	------
Departures	------	------	------	+.07	------	+.18	------	------	------	------	------

*Extrapolated.

[1] 75th Meridian Time.

TABLE 2.—*Daily totals and weekly means of solar radiation (direct+diffuse) received on a horizontal surface during April 1949*

[Gram-calories per square centimeter]

Date	Honolulu, T. H.	Pearl Harbor, T. H.	San Antonio, Tex.	Fort Worth, Tex.	La Jolla, Calif.	Riverside, Calif.	Santa Maria, Calif.	Inyokern, Calif.	Oak Ridge, Tenn.	Las Vegas, Nev.	Nashville, Tenn.	Fresno, Calif.	Davis, Calif.	Washington, D. C.	Columbia, Mo.	Soda Springs, Calif.	Grand Lake, Colo.	New York, N. Y.	Salt Lake City, Utah	State College, Pa.	Lincoln, Nebr.	Newport, R. I.	Put-in-Bay, Ohio	East Wareham, Mass.	Blue Hill, Mass.	Boston, Mass.	Ithaca, N. Y.	Twin Falls, Idaho	Albany, N. Y.	East Lansing, Mich.	Madison, Wis.	Portland, Maine	Toronto, Canada	Summit, Mont.
1949	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Apr. 2	579	610	512	311	247	350	384	594	302	541	339	354	584	542	86	313	369	519	456	578	282	589	590	580	567	521	347	476	583	488	501	----	394	(431)
Apr. 3	450	636	500	456	551	612	630	(627)	184	606	104	624	610	286	----	693	682	368	555	474	324	475	569	478	451	378	118	545	355	522	593	----	321	440
Apr. 4	569	597	210	176	548	614	638	642	536	631	550	619	607	530	608	693	620	207	582	653	407	141	612	140	105	108	386	535	217	514	563	----	545	533
Apr. 5	486	638	634	660	368	347	482	455	60	563	59	555	524	187	----	(666)	684	375	543	305	575	560	115	560	572	490	234	484	520	220	253	----	301	329
Apr. 6	630	579	651	613	311	210	511	237	602	432	601	320	431	358	596	(438)	679	88	607	134	572	136	327	98	70	30	15	535	58	300	459	----	136	517
Apr. 7	662	548	642	607	263	488	431	471	475	347	511	546	596	320	501	(234)	668	464	443	268	584	537	447	417	450	418	182	281	301	220	492	----	283	564
Apr. 8	549	601	452	312	604	564	646	658	599	586	582	654	618	489	620	(669)	196	360	119	297	441	253	549	213	229	184	171	541	462	409	443	----	510	281
Means	561	602	514	478	413	455	532	526	394	529	392	525	567	387	482	529	557	340	472	387	455	384	458	355	349	304	208	485	357	382	485	----	356	442
Departures	−23	+18	----	----	−79	−9	----	----	----	----	−24	+24	+74	+11	+20	−33	+27	−6	−4	+22	+63	−20	+92	−20	−33	−28	−59	+58	----	+76	+113	----	+12	+20
Apr. 9	521	617	152	197	587	656	655	688	530	655	428	636	582	607	485	(716)	531	----	629	626	91	303	623	267	304	220	64	583	230	561	584	----	596	569
Apr. 10	567	472	440	295	598	638	670	687	402	676	457	648	596	631	52	708	542	----	620	635	215	645	595	554	631	607	397	568	606	515	492	----	576	581
Apr. 11	541	414	343	218	487	633	554	681	112	662	166	598	539	212	205	626	723	----	582	483	601	616	621	574	584	542	392	527	593	514	566	----	503	394
Apr. 12	599	589	661	664	346	635	500	688	148	674	157	664	624	299	592	(729)	681	568	434	535	606	613	548	577	627	550	382	330	604	494	577	----	489	202
Apr. 13	684	613	508	638	576	568	444	679	172	672	331	671	642	59	626	(731)	372	224	610	61	506	299	144	314	464	428	102	596	396	465	572	----	246	295
Apr. 14	712	600	625	676	382	442	144	636	572	671	642	620	581	429	89	(589)	287	----	637	435	94	363	535	----	200	167	316	595	476	(430)	236	----	500	473
Apr. 15	492	552	299	471	482	393	516	319	584	619	500	588	624	558	386	723	732	----	642	468	507	298	80	234	167	94	162	584	343	(102)	158	----	59	529
Means	588	551	432	451	494	566	498	625	360	661	369	632	598	399	348	703	552	----	593	463	374	448	450	420	425	372	259	540	464	440	455	----	424	434
Departures	−6	+6	----	----	−27	+85	----	----	----	----	−3	+82	+46	+1	−4	+59	−14	----	+45	+69	−35	+41	+70	+26	+52	+26	−33	+84	----	+91	+49	----	+48	−4
Apr. 16	732	416	587	698	-------	623	530	676	191	675	486	624	545	336	677	728	697	----	632	139	523	425	391	447	296	258	57	580	169	558	617	----	230	476
Apr. 17	737	620	406	647	-------	664	419	546	551	272	448	548	547	618	662	572	734	----	482	654	623	199	329	172	163	139	440	576	279	218	73	----	602	627
Apr. 18	673	365	284	646	191	320	260	674	673	672	675	676	563	205	472	484	572	----	560	194	668	305	122	406	250	334	41	547	144	42	277	----	31	616
Apr. 19	648	521	54	116	284	157	680	545	650	533	672	644	645	471	657	600	651	----	405	153	424	570	559	491	438	411	130	290	212	561	644	----	133	(367)
Apr. 20	653	561	191	170	574	640	584	667	495	684	390	646	541	634	490	683	372	----	447	611	335	576	630	588	630	534	409	523	647	534	592	----	508	245
Apr. 21	596	512	185	244	582	654	696	692	163	699	85	696	633	568	479	714	650	----	553	547	184	565	608	563	605	561	363	572	555	528	578	----	482	279
Apr. 22	435	329	490	223	525	644	669	631	421	680	507	642	592	64	634	712	561	300	655	155	574	551	380	524	566	514	141	603	431	443	575	----	121	468
Means	639	475	314	392	431	529	548	633	449	602	466	639	581	414	582	642	605	----	533	350	476	456	431	456	421	393	226	527	348	412	479	----	301	442
Departures	+29	−36	----	----	−65	+19	----	----	----	----	+4	+51	+4	−5	+109	−17	+22	----	−6	−48	+31	+36	+2	+40	+28	+11	−63	+43	----	+23	+72	----	−51	−16
Apr. 23	732	546	253	282	385	654	671	611	617	698	638	624	584	394	718	549	722	362	553	276	661	510	577	507	526	474	161	336	298	422	422	----	353	456
Apr. 24	490	603	72	286	252	625	636	704	----	608	698	638	583	472	723	(758)	670	394	552	278	641	562	196	440	463	467	45	614	338	286	638	----	438	653
Apr. 25	313	440	284	244	311	447	657	568	704	486	729	459	640	674	643	(777)	463	654	469	683	610	703	556	652	690	620	374	636	736	423	383	----	300	508
Apr. 26	452	428	352	337	319	491	487	681	612	700	474	506	669	626	115	(777)	286	457	588	551	416	482	272	373	378	335	132	629	210	188	369	----	156	500
Apr. 27	627	565	411	335	530	558	720	717	108	708	249	704	499	174	287	693	571	614	660	657	486	486	588	438	558	533	351	574	640	562	639	----	440	632
Apr. 28	751	696	352	409	545	602	674	646	391	656	417	626	518	607	721	406	781	746	424	731	645	705	728	557	670	563	464	422	543	589	683	----	642	486
Apr. 29	637	522	528	361	470	443	717	719	148	695	131	759	672	645	723	593	503	660	224	711	639	568	639	484	617	522	263	603	380	573	668	----	344	314
Means	572	543	322	322	402	546	652	664	430	650	476	616	595	513	561	650	571	555	496	555	585	574	508	493	557	502	256	545	449	435	543	----	382	516
Departures	−31	+13	----	----	−108	+65	----	----	----	----	+43	+38	+42	+64	+106	+12	−26	+107	−27	+128	+156	+102	+81	+35	+108	+113	−113	+37	----	+64	+104	----	+54	+25

ACCUMULATED DEPARTURES ON APRIL 29, 1949

	+56	+70	----	----	−4,095	+63	----	----	----	----	+1,092	+4,277	+1,092	−1,092	+266	+434	----	----	−175	+1,624	−1,722	+161	+2,212	−938	+441	+434	−8,099	+2,296	----	−903	+1,953	----	+224	+336

Note—Figures in parentheses are interpolated.

TABLE 3.—*Daily totals and weekly means of solar and sky radiation plus the radiation reflected from the ground, as received on a vertical surface facing south at Blue Hill, Mass., during April 1949*

Date	2	3	4	5	6	7	8	Mean	9	10	11	12	13	14	15	Mean	16	17	18	19	20	21	22	Mean	23	24	25	26	27	28	29	Mean
Gm cal/cm²	388	299	43	371	26	267	125	217	140	372	333	358	260	88	60	230	130	61	107	220	307	303	286	202	249	189	310	170	260	289	268	248

U. S. GOVERNMENT PRINTING OFFICE: 1949

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, April 1949

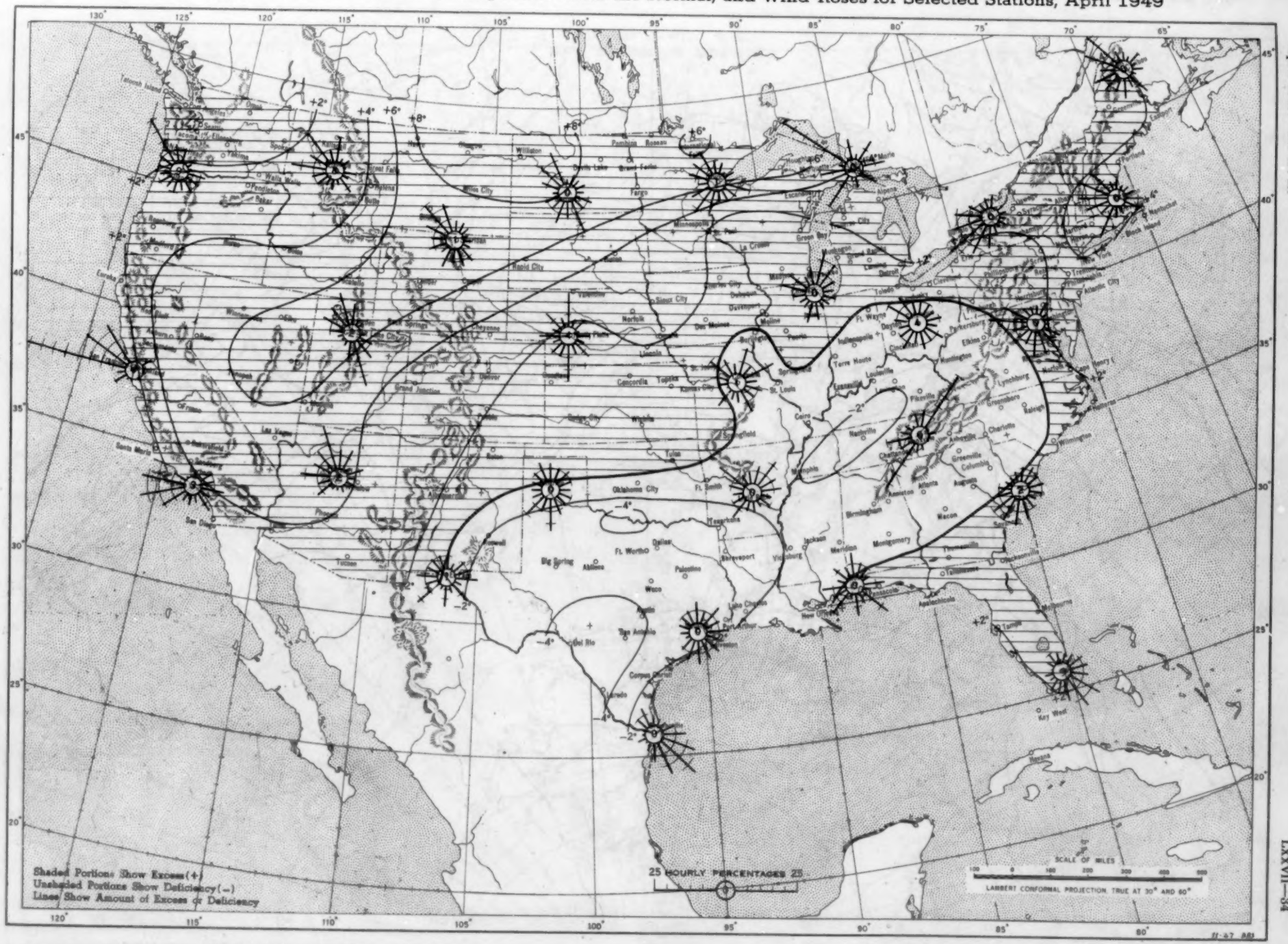
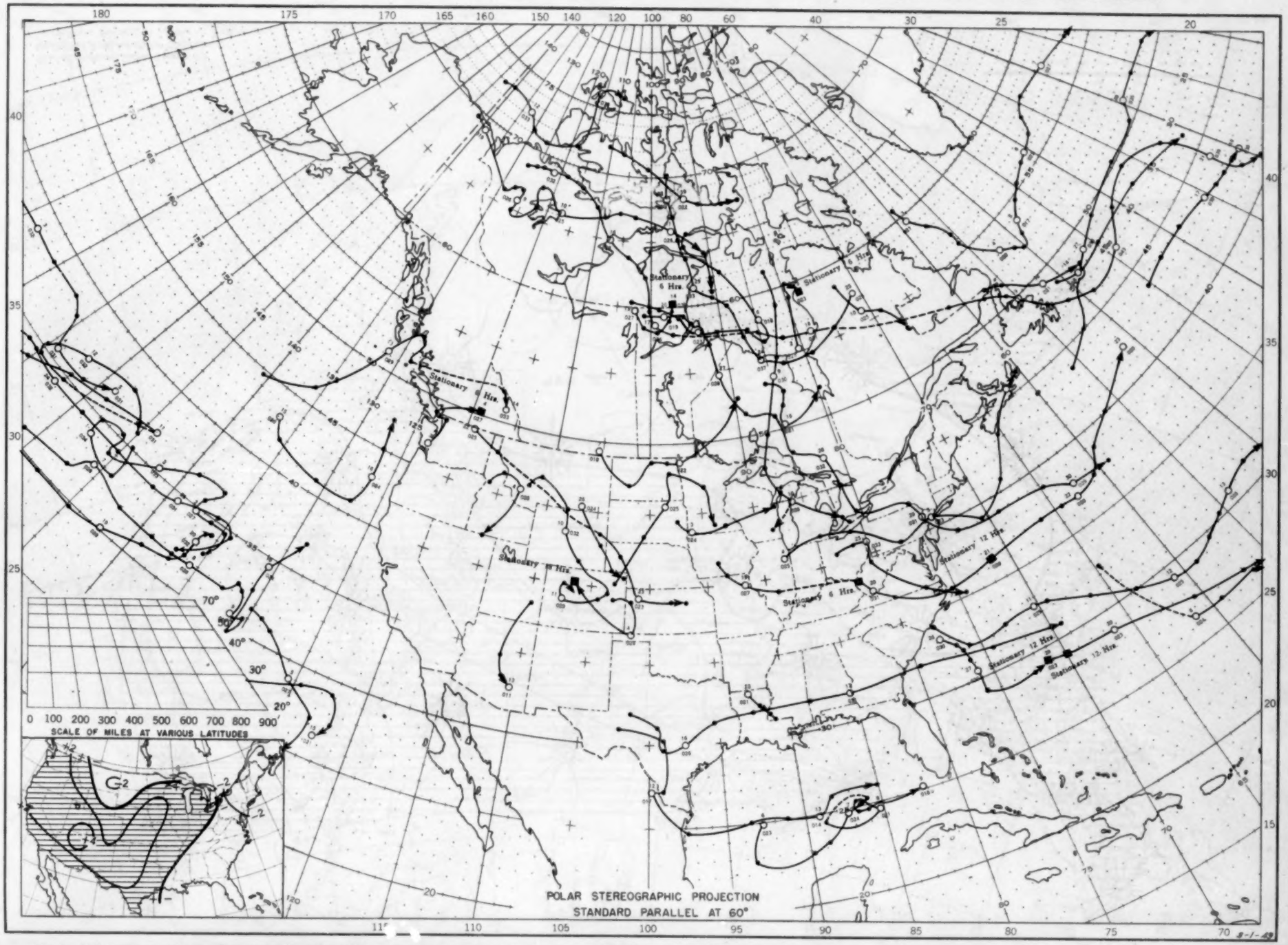

Shaded Portions Show Excess(+)
Unshaded Portions Show Deficiency(−)
Lines Show Amount of Excess or Deficiency
25 HOURLY PERCENTAGES 25
SCALE OF MILES
LAMBERT CONFORMAL PROJECTION, TRUE AT 30° AND 60°

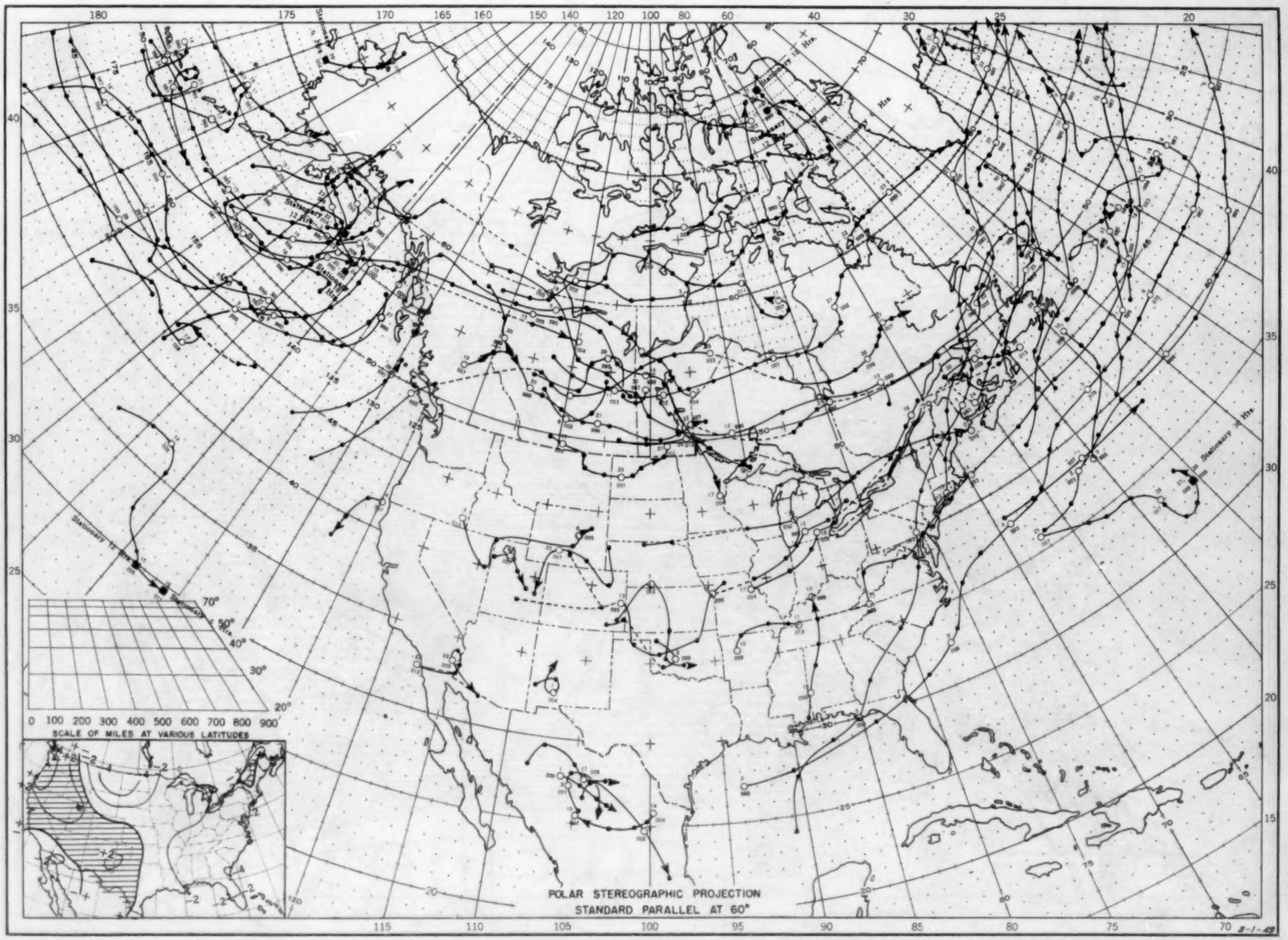
Chart II. Tracks of Centers of Anticyclones, April 1949. (Inset) Departure of Monthly Mean Pressure from Normal



Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time). Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time). Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart III. Tracks of Centers of Cyclones, April 1949. (Inset) Change in Mean Pressure from Preceding Month


0 100 200 300 400 500 600 700 800 900
SCALE OF MILES AT VARIOUS LATITUDES
POLAR STEREOGRAPHIC PROJECTION
STANDARD PARALLEL AT 60°

Circle indicates position of cyclone at 7:30 a. m. (75th meridian time) Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, April 1949

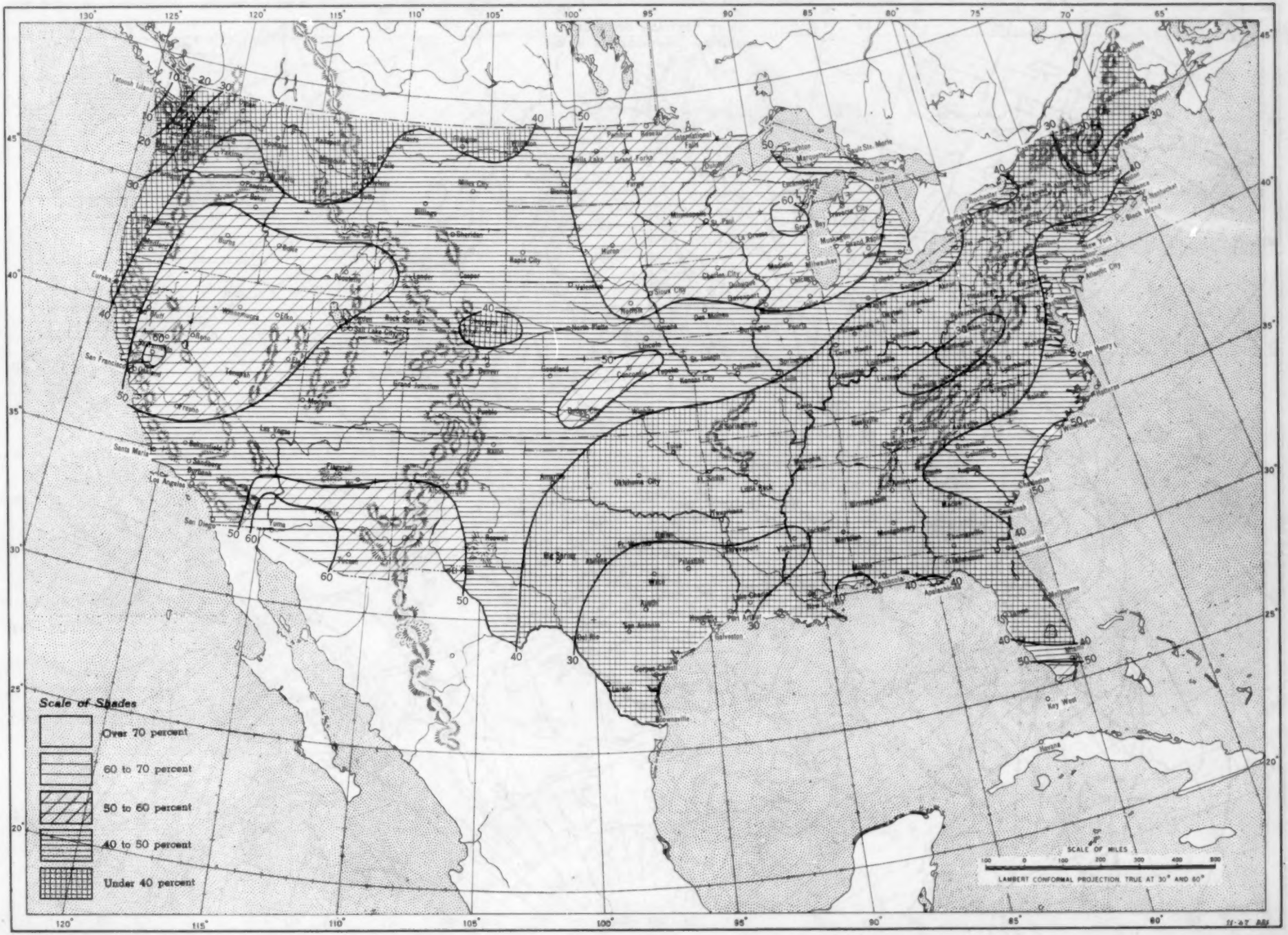

Scale of Shades
Over 70 percent
60 to 70 percent
50 to 60 percent
40 to 50 percent
Under 40 percent
SCALE OF MILES
LAMBERT CONFORMAL PROJECTION, TRUE AT 30° AND 60°

Chart V. Total Precipitation, Inches, April 1949. (Inset) Departure of Precipitation from Normal

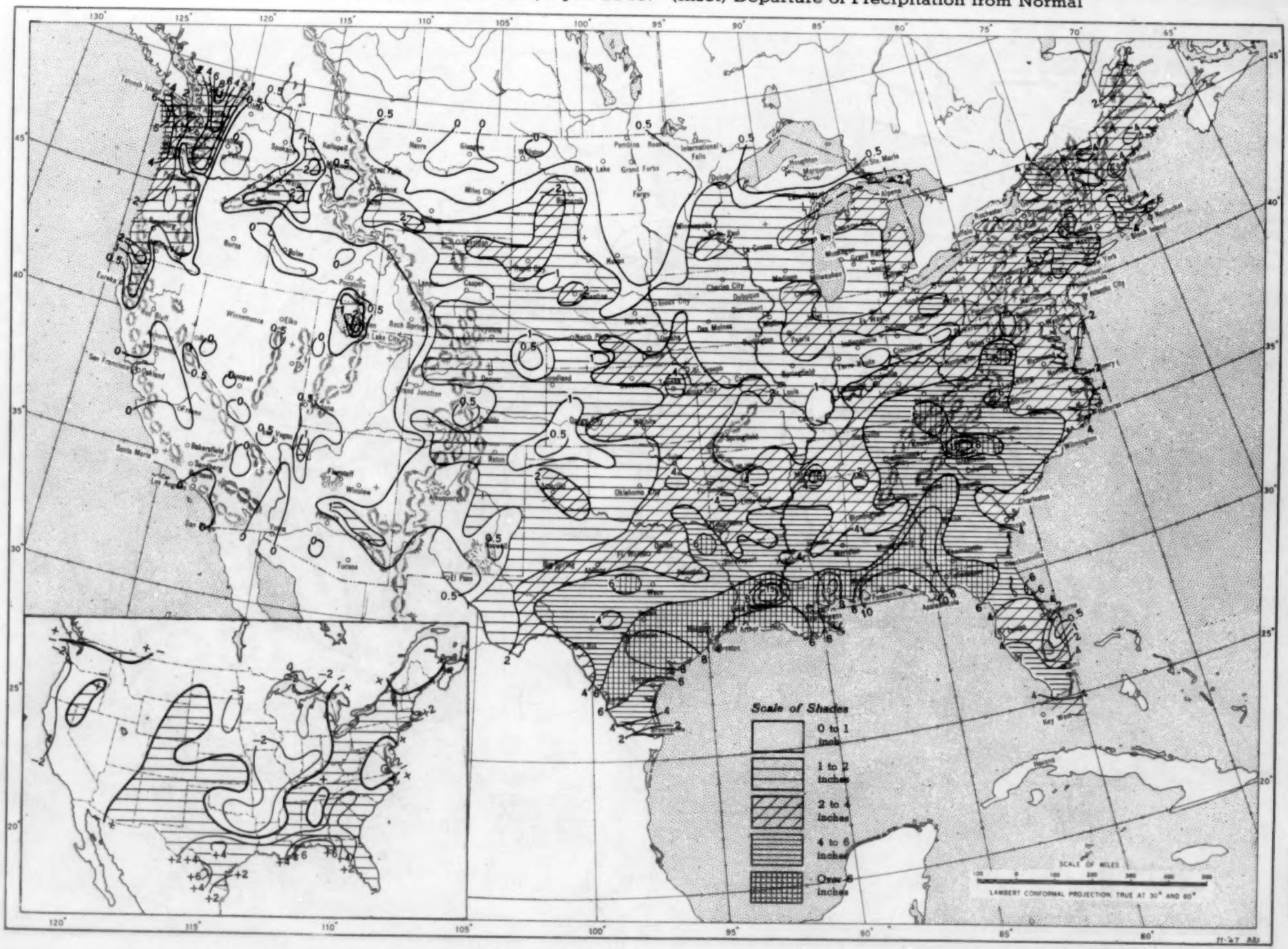
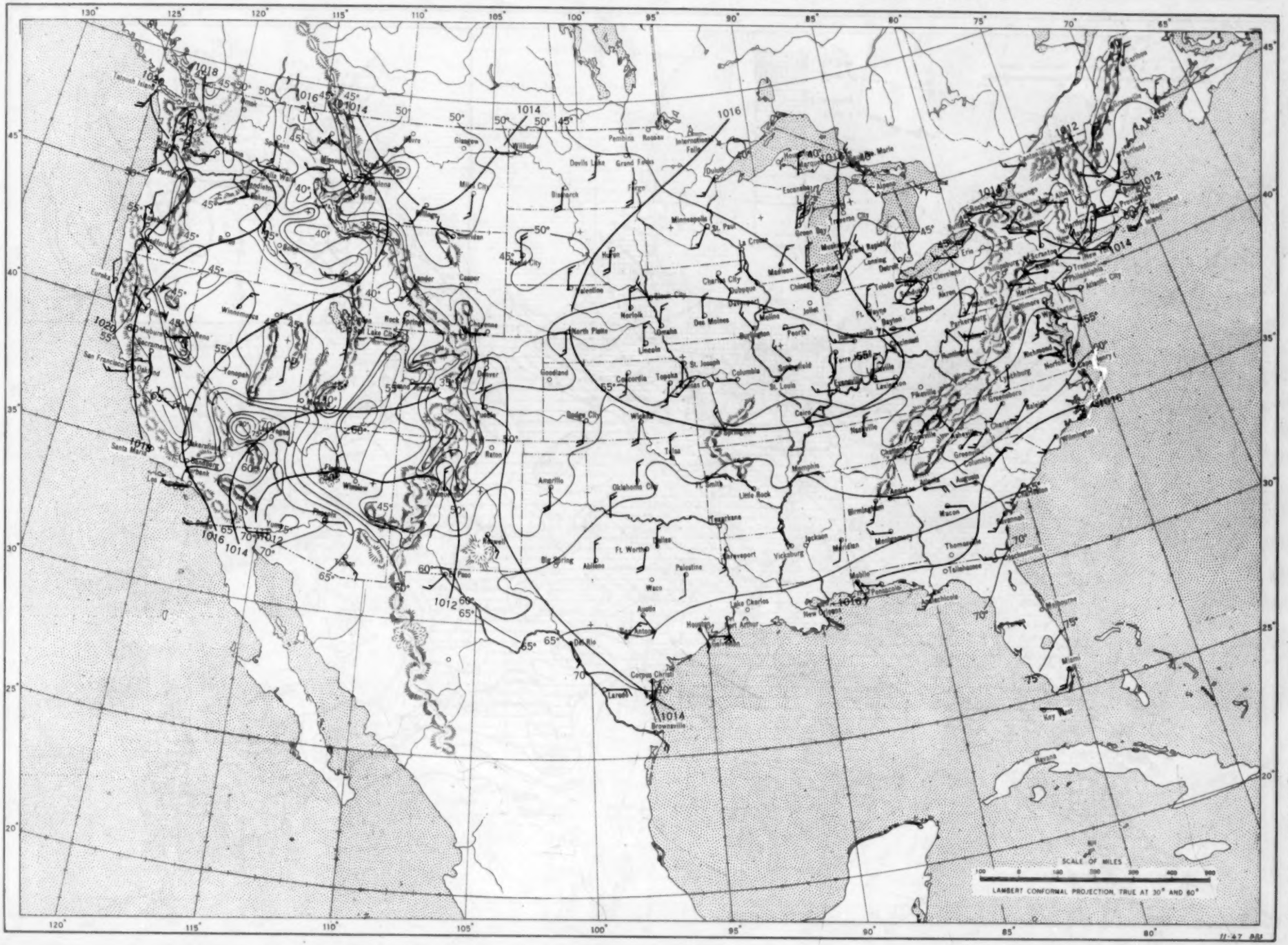

Scale of Shades
0 to 1 inch
1 to 2 inches
2 to 4 inches
4 to 6 inches
Over 6 inches
SCALE OF MILES
LAMBERT CONFORMAL PROJECTION, TRUE AT 30° AND 60°

Chart VI. Isobars (mb.) at Sea Level and Isotherms (°F.) at Surface; Prevailing Winds, April 1949



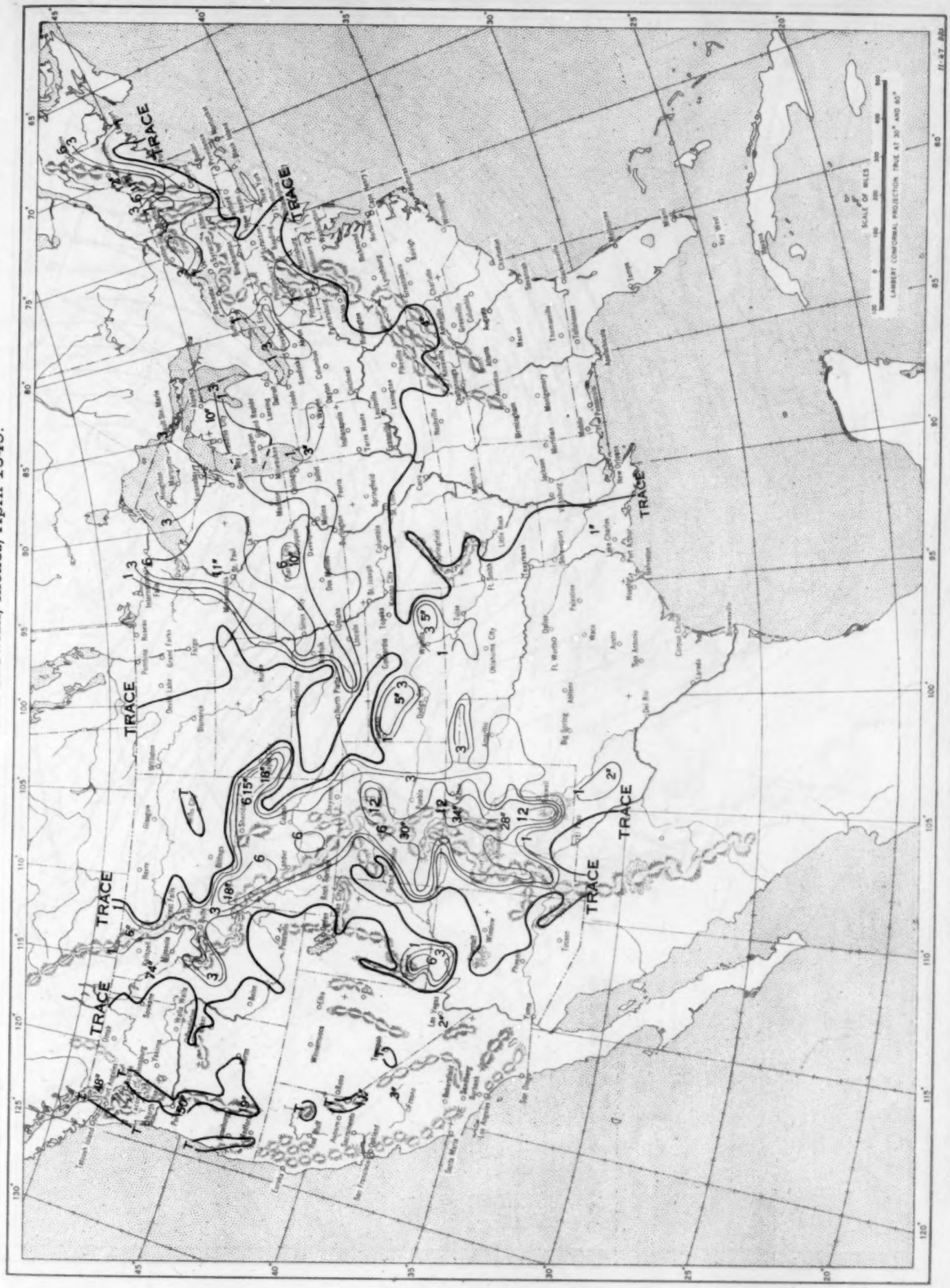


Chart VII. Total Snowfall, Inches, April 1949.

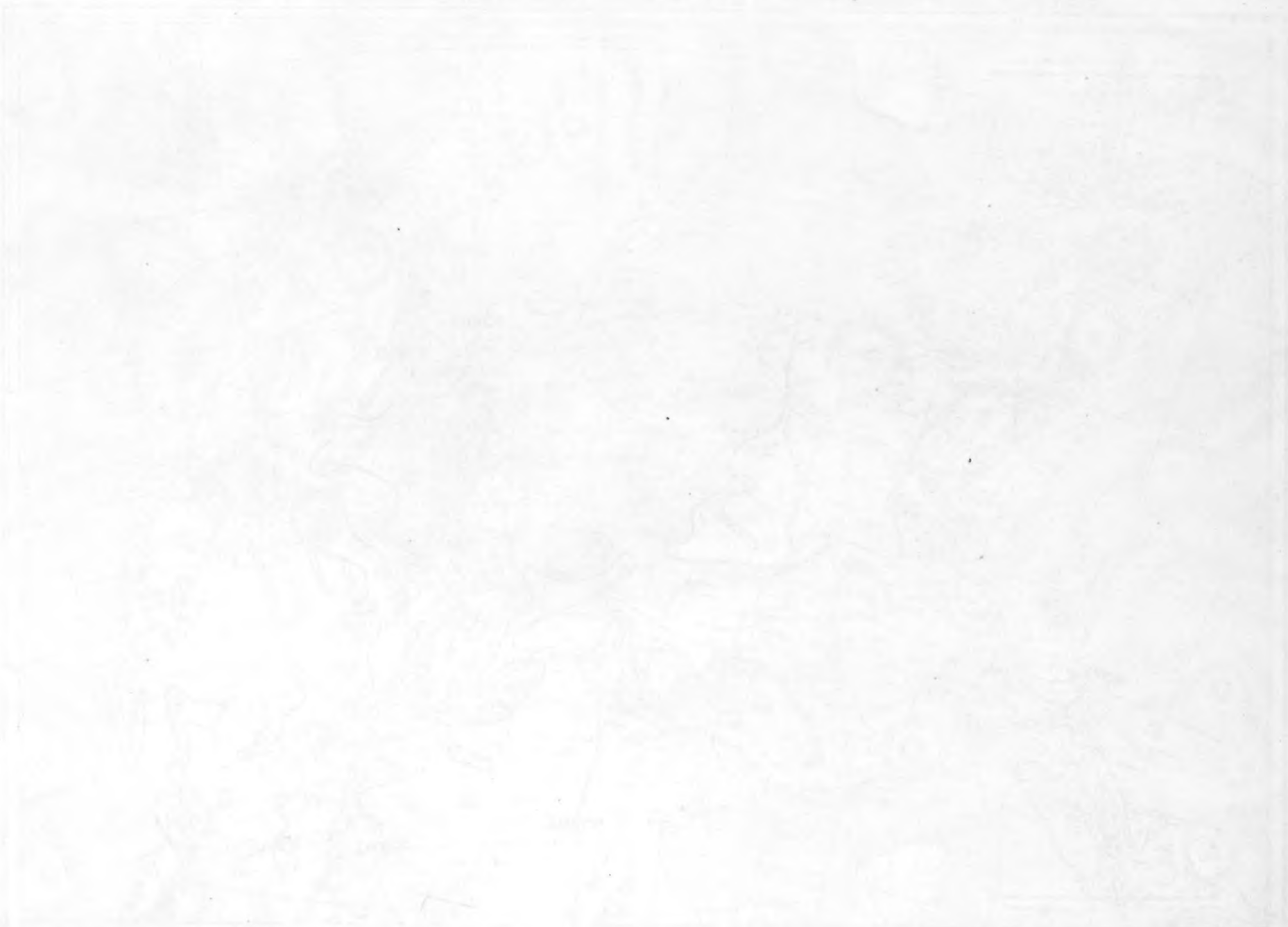
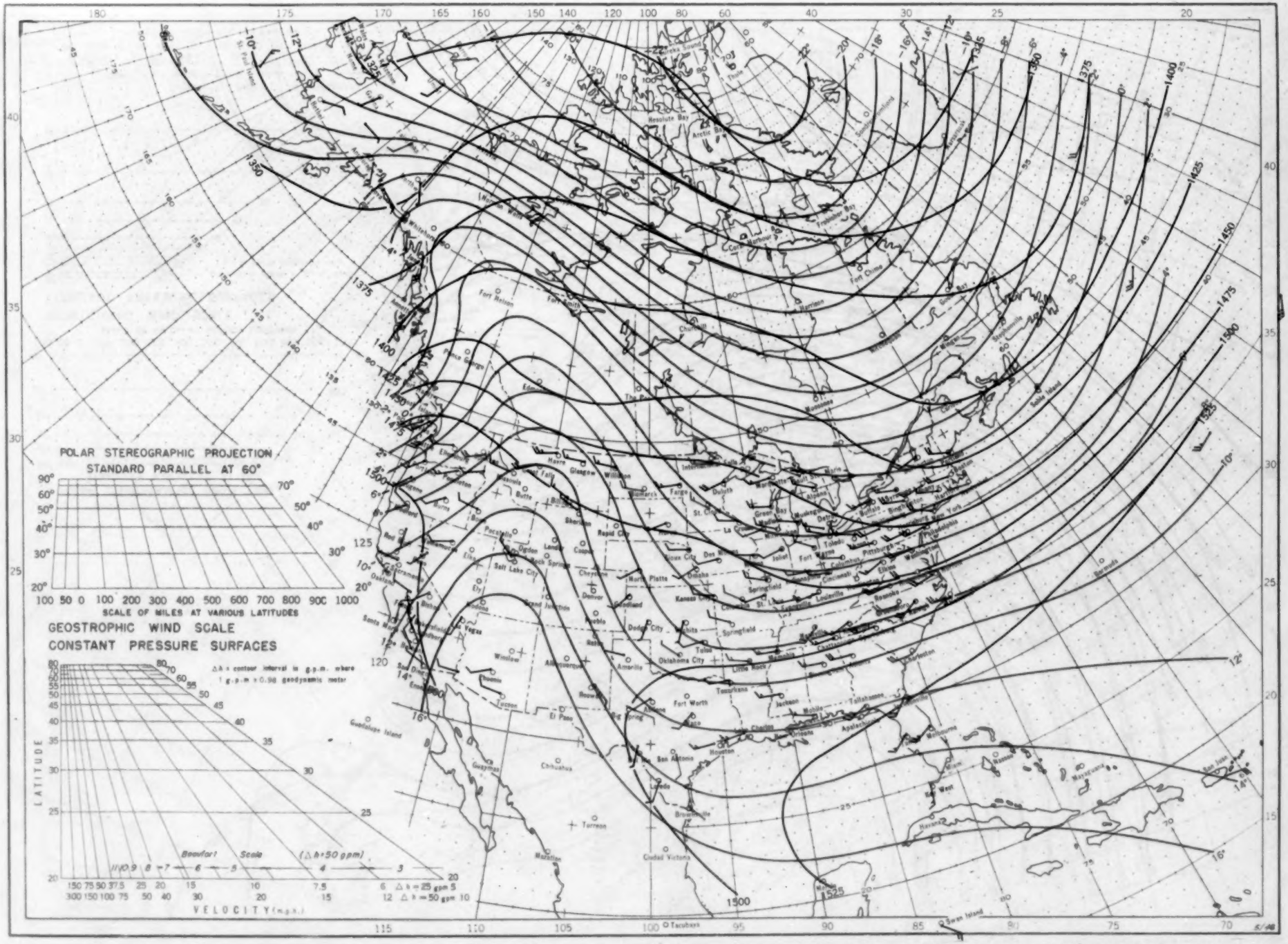


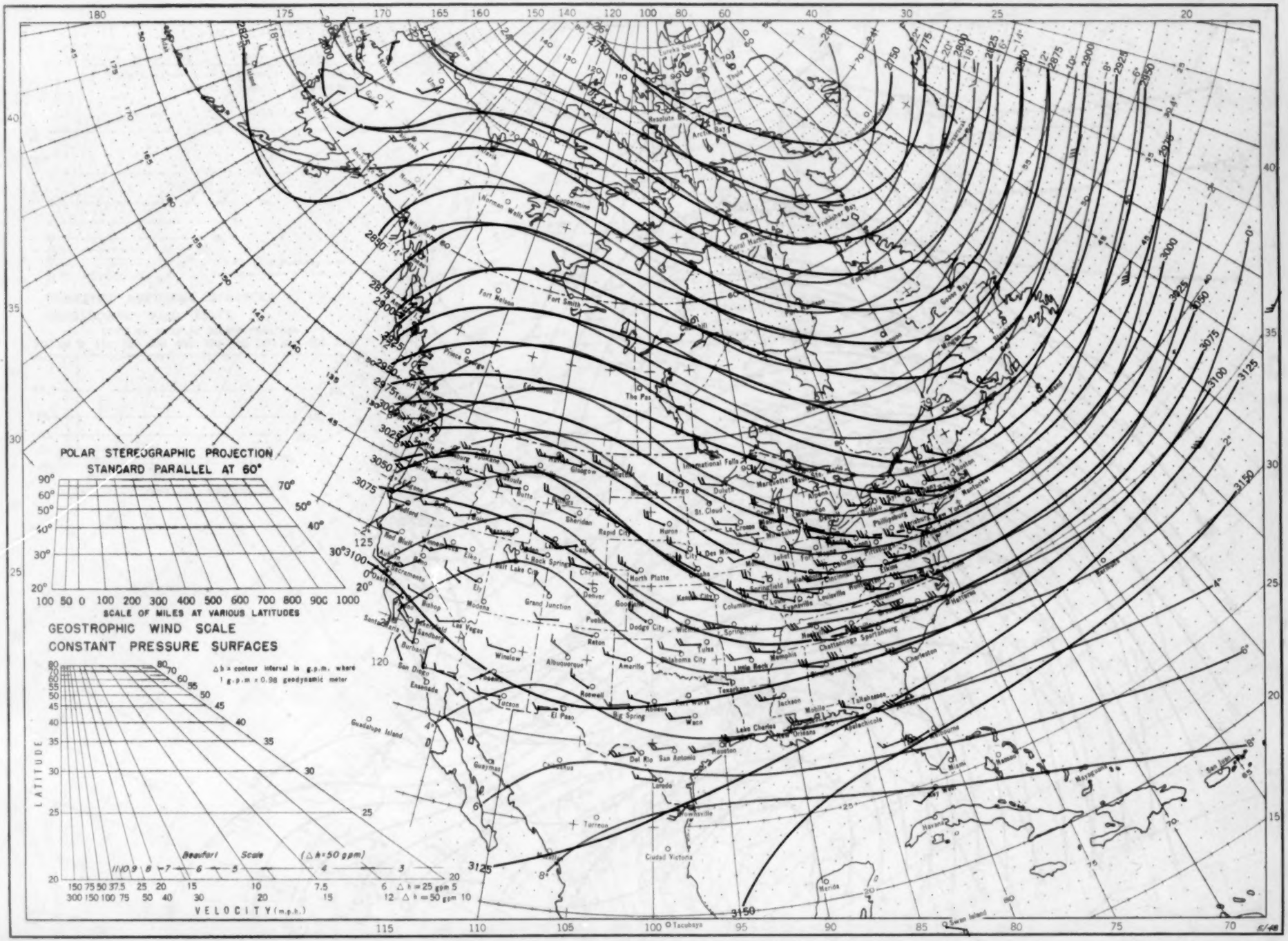
Chart VIII. April 1949 — Contour Lines of Pressure in Millibars

Chart VIII, April 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 850-millibar Pressure Surface, and Resultant Winds at 1,500 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

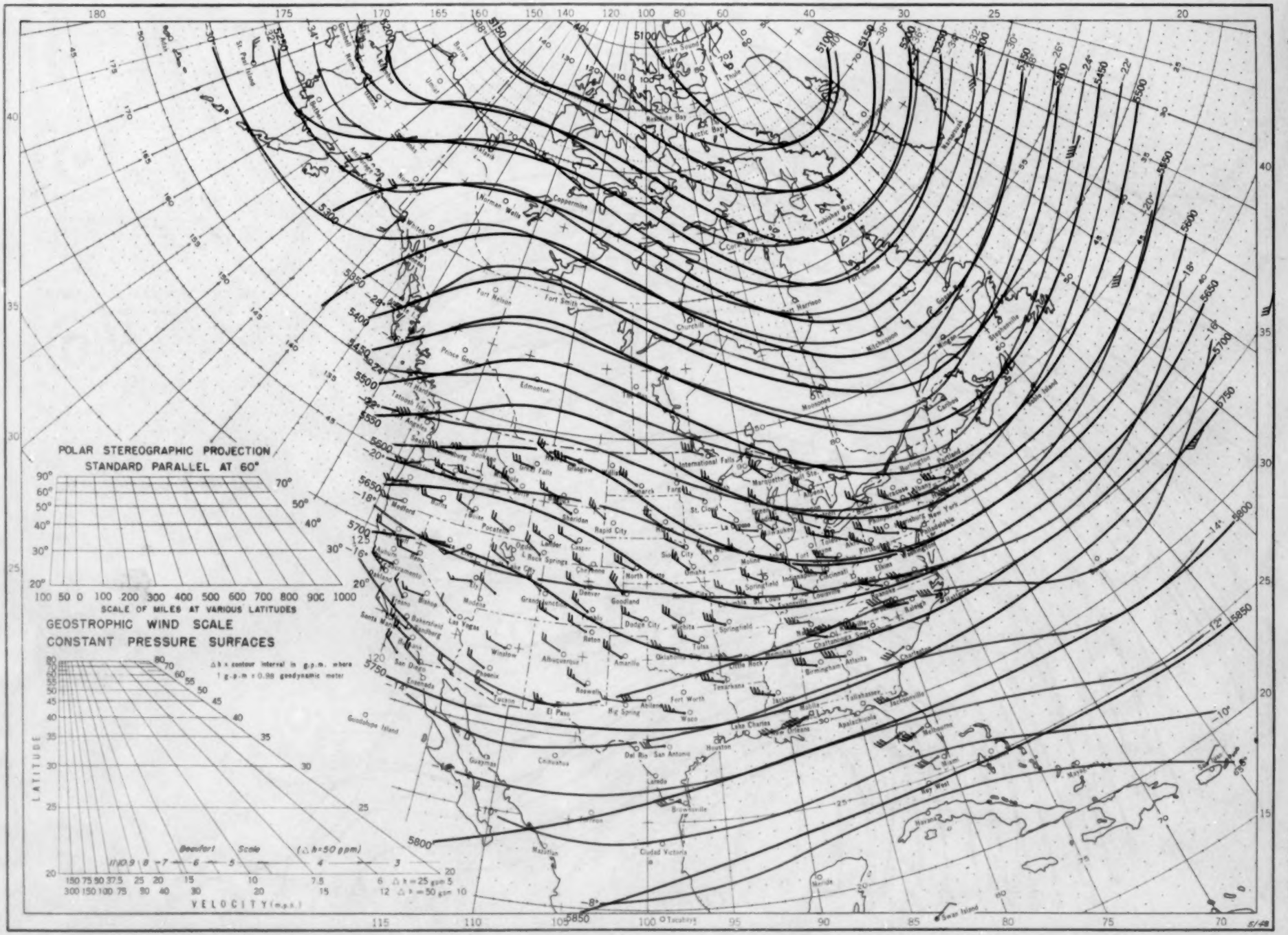
Chart IX, April 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 700-millibar Pressure Surface, and Resultant Winds at 3,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

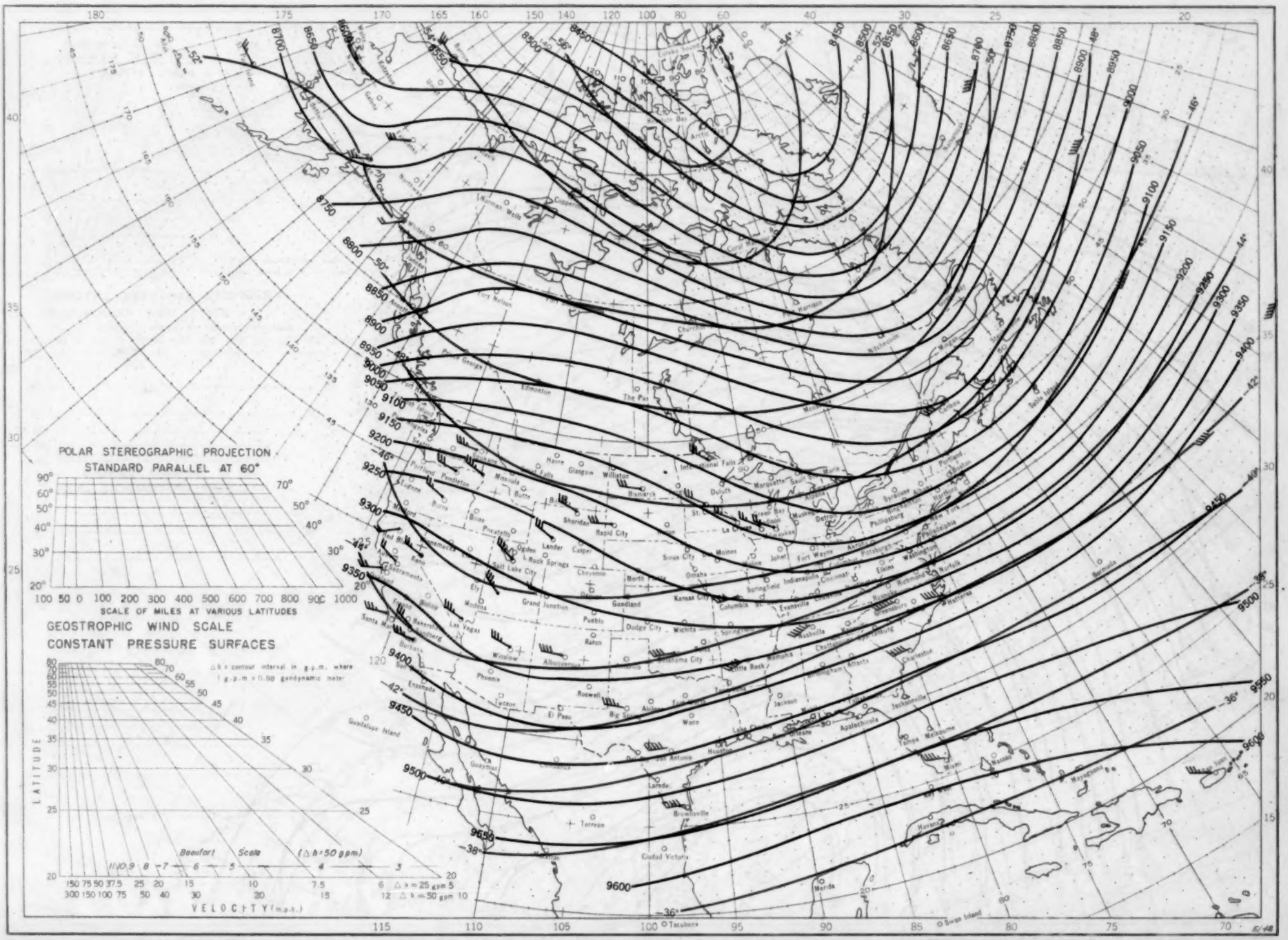
Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart X, April 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 500-millibar Pressure Surface, and Resultant Winds at 5,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart XI, April 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 300-millibar Pressure Surface, and Resultant Winds at 10,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.